

genera are developed strictly on separate plants from the seed structures. Nine of the twelve genera being recognized here occur in the tropics and four of these are endemic to the tropics. All but a few species of the family grow in very moist areas, some, particularly in Tasmania, being found beyond the tree line as small or prostrate shrubs. Most, however, are large forest trees, many with broad leaves quite unlike the usual conception of conifers.

Within Podocarpaceae there has been great variation in the size and complexity of the recognized genera. The genus *Podocarpus* as generally treated involves up to eight sections and well over one hundred species, the differences between some of these sections being every bit as great as those which separate most other genera. It is being proposed here to divide *Podocarpus* into five separate genera in order to produce a more balanced treatment of the family. In addition, one new genus is separated from *Dacrydium* because of the different form of the fertile shoots and the strikingly different foliage morphology. The result is a total of twelve genera in the family, of which nine are to be considered in this study, six in part I and three in part II.

KEY TO THE GENERA OF PODOCARPACEAE

1. Seed cone compact, seeds not subterminal.
 2. Ovules inverted.
 3. Cones produced on ordinary foliage branches; adult leaves in the form of scales.
 4. Seed partly covered by an epimatium; leaves opposite, decussate. (*Microcachrys*, not tropical).
 4. Seed completely enveloped in the fertile scale or epimatium; leaves spirally arranged. (some species of *Dacrydium*, not tropical).
 3. Fertile shoot specialized; adult leaves linear, flat, constricted at the base. (*Saxegothaea*, not tropical).
 2. Ovules erect.
 5. Fertile scale lacking; adult leaves developed. (*Microstrobis*, not tropical).
 5. Fertile scale an epimatium; adult leaves suppressed in favor of phylloclads. *Phyllocladus*.
1. Seeds one or a few, subterminal or dispersed near the end of a fertile branch.
 6. Seed free, projecting above an epimatium (fertile scale).
 7. Seed structures terminal on ordinary foliage branches; leaves crowded, awl-like, linear, or scale-like. *Dacrydium* (most species).
 7. Seed structures lateral on specialized shoots; leaves bilaterally flattened and distichous. *Falcatifolium*.
 6. Seed covered by or fused with the scale.
 8. Fertile bract forming a terminal crest over seed complex; leaves awl-like. *Dacrycarpus*.
 8. Fertile bract separate from the seed complex; leaves flat.
 9. Seed complex becoming erect; leaves bilaterally flattened. *Acropyle*.

9. Seed complex remaining inverted, leaves bifacially flattened.
10. Fertile shoot terminal on ordinary foliage branches; leaves scale-like; parasitic shrub. [*Podocarpus* sect. *Microcarpus*].¹
10. Specialized fertile shoot, usually axillary; leaves broad and flat, usually distichous; not parasitic.
11. Fertile shoot scaly; leaves never with both hypoderm and accessory transfusion tissue.
12. Seed with a beak; leaves with hypoderm, usually amphistomatic and decussate, oval or lanceolate. *Decussocarpus*.
12. Seed without a beak; leaves without hypoderm, spirally placed and hypostomatic, linear. *Prumnopitys*.
11. Fertile shoot divided into a naked peduncle and a specialized fleshy receptacle; leaves with both hypoderm and accessory transfusion tissue. *Podocarpus*.

Phyllocladus L. C. & A. Rich. ex Mirbel, Mém. Mus. Hist. Nat. Paris 13: 48. 1825, nom. cons. Type species: *Phyllocladus billardieri* Rich. ex Mirbel [*Phyllocladus aspleniifolius* (Labill.) Hooker].

Podocarpus Labill. Nov. Holl. Pl. Sp. 2: 71, t. 221. 1806. Type species: *Podocarpus aspleniifolius* Labill. [*Phyllocladus aspleniifolius* (Labill.) Hooker].

Brownetera L. C. Rich. Ann. Mus. Paris 16: 299. 1810. *Nomen nudum* based on *Podocarpus aspleniifolius*.

Thalamia Sprengel, Anleitung zur Kenntniss der Gewächse. ed. 2. 2: 218. 1817, based on *Podocarpus aspleniifolius*.

Small to large trees; bark dark brown or blackish and smooth, reddish and fibrous within, shed in large thin flakes; abundantly branched, branches often in whorls; juvenile leaves linear or slightly broader near the apex, acute or rounded but with a small spine-like point, 1 mm. or more wide and about 1 cm. long, changing rapidly on small plants to flattened leaf-branch complexes or phylloclads with scale-leaves on non-foliage branches; leaves represented by small spurs on the margins of the phylloclads, strongly keeled on the dorsal side, triangular in cross section and on older plants scarcely or not distinguishable; phylloclads extremely variable in shape, broad, dorsiventrally slightly differentiated in some cases, reaching several cm. in length or aggregated along branches in complexes to more than 20 cm. long or transitional as a large deeply lobed phylloclad; monoecious, but individual trees may be unisexual; pollen cones in clusters but the central axis of the cluster in most cases continuing growth, nearly sessile or stalked; seed cone consisting of several or numerous scales some of which are sterile, single ovules erect in the axil of a scale; seed cones terminal or marginal on fully grown or reduced phylloclads or clustered as are the pollen cones, becoming swollen, fleshy or leathery; erect seeds as many as 20 per cone but usually only 2 or 3, with a filmy aril (symmetrical but rough edged epimatium) growing as

¹ To be taken up as a genus elsewhere.

a cup around the lower half, protruding beyond the scale when ripe, oval, wider than thick, with the micropyle as a crooked tip, about 3 mm. long.

The genus consists of five closely related species in mild to cool and very moist climates, three in New Zealand, one in Tasmania, and one in mountain areas from the Philippines to New Guinea. *Phyllocladus* is sharply distinguished from related taxa by the distinctive phylloclads which give it the popular name of "celery-topped pine." The bark contains abundant tannin and the wood is of good quality but, because all of the forest species grow as scattered individuals, its commercial value is limited. One species in New Zealand and part of the population in Tasmania grow as bushy pioneer plants around mountain meadows. The one tropical example of this genus is the only podocarp species growing in the tropics whose seeds are produced in a recognizable cone. This certainly suggests that the family Podocarpaceae, so abundantly developed within the tropics, had its origins in cooler climate areas.

1. *Phyllocladus hypophyllus* Hooker f. Icon. Pl. t. 889. 1852. Type: *Low s.n.*, Mt. Kinabalu.

Phyllocladus hypophyllus var. *protracta* Warb. Monsunia 1: 194. 1900.
Syntypes: Warburg 14722, S. Mindanao, mountain forest of Dagatpan and 18272, Batjan (not seen).

Phyllocladus protractus (Warb.) Pilger, Pflanzenreich IV. 5 (Heft 18): 99. 1903.

Phyllocladus major Pilger, Bot. Jahrb. 54: 211. 1916. Type: *Ledermann 9872*, Lordberg, NE. New Guinea.

Common small tree on ridges or becoming quite large in the forest, 30 m. or more high; bark hard, rough with large lenticels, dark brown, breaking off in large scales; inner bark straw color; branches more or less whorled around the main stem and densely ramified; foliar buds on young plants with long thin and somewhat spreading bracts, these becoming tighter and more globular on older plants; phylloclads sometimes glaucous, particularly underneath, variable in shape, deeply lobed on young specimens but becoming less lobed in maturity, margins nearly entire to wavy with individual lobes ca. 5 mm. wide and 2 mm. long, oval to triangular, 3 or 4 cm. long and 2 cm. wide, single or aggregated alternately along lateral branches of limited growth; pollen cones clustered around a shoot that continues growth, peduncle 5–25 mm. long; mature pollen cones to 15 mm. long, 3 mm. in diam.; seed cones clustered on stalks about 1 cm. long or terminal on a slightly modified phylloclad or any possible intermediate condition, small, with 1–3 or more fertile scales, first red when mature, then brown and leathery.

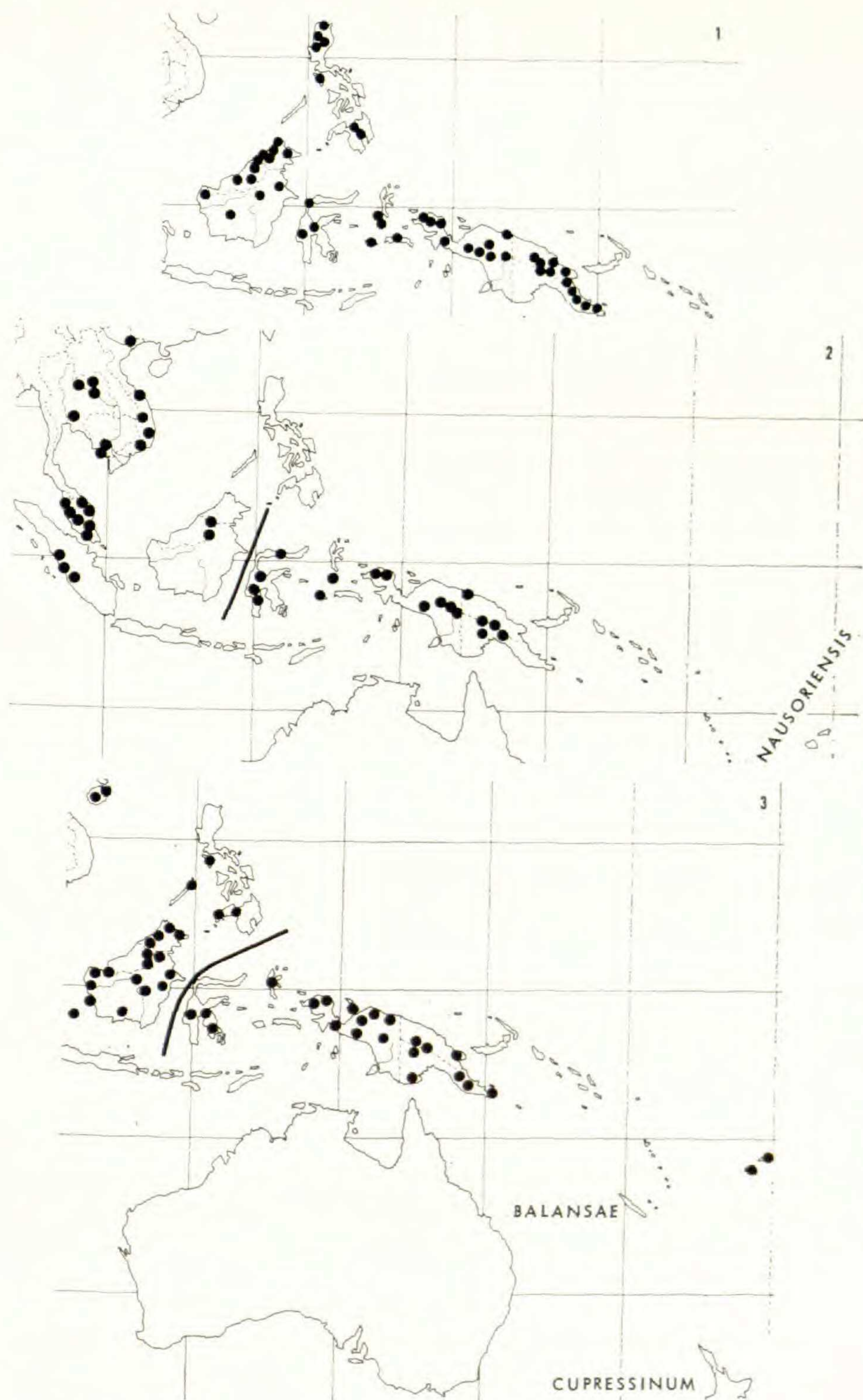
DISTRIBUTION. Luzon and Borneo to New Guinea, scattered and often common in moist forests and on ridges generally, from 1,500 to 3,200 meters, and occasionally from 900 to 4,000 meters. MAP 1.

Sarawak. Mt. Poi, upper cave, *Clemens 20026 j* (NY). Mt. Laiun, *Richards*

2421 s 1,100 m. (K). Mt. Mulu (Baram), *Winkler* 512 j 1,200 m. (L), *Shockton* 2699 s 6-7,000 ft. (K), *Anderson* 4544 ♀ 7,000 ft. (K, L), *Hotta* 14743 ♀ 1,600-2,200 m. (L). Mt. Temedu, Hose Mts., *Ashton* S19025 s (K). Mt. Dulit, *Richards* 1058 j 1,000-1,230 m. (A, BM, K, L, US), 1628 j 1,230 m. (K), 2476 s 800 m. (A, BM, K, L). Marigan Range, Lawas, *Brunig* S9984 ♀ 1,000 m. (L). Without loc. *Beccari* 2391 s (K), 3220 ♀ (K). **Brunei.** Mt. Ulak, *Ashton* BRUN 1033 s 4,300 ft. (K, L). **North Borneo.** Jesselton, Kumu Rengis, *Wyatt-Smith* [?] 71650 ♀ 80 ft. [sic] (K, L, US). Penampang, *Leaño-Castro* 5992 s 6,000 ft. (K, L), *Clemente* 6217 s 5,000 ft. (K). Ranau, *Meijer* SAN 21968 ♀ 5-6,000 ft. (K), *Mikil* 56277 s 7,000 ft. (K), *Burgess* SAN 25167 s 4,500 ft. (K). Mt. Kinabalu, *Low* s.n. ♀ 8,000 ft. (K-holotype), s.n. ♂ 10,000 ft. (K), *Gibbs* 4088 j 7,000 ft. (BM, K), 4152 ♀, j 6,000 ft. (BM, K), 4238 s (BM), 4273 ♀ 9-12,000 ft. (BM, K), *Clemens* 10556 ♂ (A), 10565 ♀ (A, GH, K), 10654 ♀ (A), 10957 s (BM), 27930 ♀ 6,000-13,500 ft. (A, BM, K, L, NY), 29328 ♀ 10,000 ft. (A, BM, ILL, K, L, NY), 29743 ♀ 8-9,000 ft. (BM, K, NY), 30029 ♀ 7,000 ft. (A), 30030 ♀ 10,500 ft. (K, NY), 31838 ♂ 7,000 ft. (A, L), 31927 ♂ 8-9,000 ft. (NY), 32459 s (BM, L), 50626 s (BM), 50784 ♀ 7-9,000 ft. (A, BM, L), 50797 ♀ 10,000 ft. (BM, L), 51220 s (BM), *Haviland* 1092 ♀, ♂ 11,000 ft. (A, BM, K, L), *Sinclair & Kadim* 9053 s 6,950 ft. (L), *Chew & Corner* RSNB 710 ♀ 7,500 ft. (K, NY), RSNB 4172 ♀ 5,000 ft. (K), RSNB 4824 ♀ 6,000 ft. (K), *Smythies* S10622 ♀ 9,000 ft. (K, L), *Wyatt-Smith* 80370 s (K), 80371 ♀ (K, L), *Anderson* S27089 ♂ 11,800 ft. (K), S27090 ♀ 11,300 ft. (K, L), *Meijer* SAN 22114 s 4,000 ft. (K), SAN 29271 ♂ 9,700 ft. (K, L). *Nicholson* SAN 17823 ♀, ♂ 8,800 ft. (K, L), *Fuchs & Colenette* 21430 ♀ 3,375 m. (K), *Carr* SFN 27617 s 11,500 ft. (BM). Trusmadi Kudat, *Mikil* SAN 31784 ♂ (L). Sobong Peak, *Lobb* (1857) s 4,000 ft. (BM, K). **Borneo.** W. Region, Bengkang, Banan, *NIFS* bb9671 j 1,400 m. (L), bb24777 j 1,200 m. (A, L). B. Raja, *Winkler* 1036 s 1,600 m. (L). Ulu Kelan, *Molengraaf* B3477 s (L). Top of Samedum, *Hallier* 697 ♀ (A, K, L, NY). Mt. Palimasan, W. Kutei (Belajan R.), *Kostermans* 12894 s 700 m. (BM, K). Mt. Niapa on Kelai R., *Kostermans* 21482 ♂ 1,000 m. (K, L). **Philippines.** LUZON: Mt. Panai (Benguet), *Gillis* 27257 s (A, K, L, US), *Merrill* 4753 j (K, L, NY, US), *Quisumbing & Sulit* 82404 s 7,700 ft. (NY). Mt. Siñgakalsa (Benguet), *Sulit* 7669 ♂ 2,500 m. (A, L). Benguet, *Alvarez* 18364 s (BM). Lepanto Dist., *Curran* 10957 ♂ (K, L, NY, US). Mt. Data, *Steiner* 2150 j 2,200 m. (L). Mt. Pukis (Bontoc), *Ramos & Edaño* 37757 ♂ (A, US). Mt. Tabuan-Buan (Cagayan), *Ramos* 77401 ♀ 5,800 ft. (K, NY). Center, *Loher* 4851 s (K), 5203 ♀ (A, K, NY, US). MINDORO: Mt. Halcon, *Merrill* 5788 s (K, NY, US). Mt. Dulangan, *Whitehead* (1896) s 5,000 ft. (BM). MINDANAO: Mt. Katanglad (Bukidnon), *Sulit* 10052 ♀ 2,200 m. (A, L), 10124 ♂ 2,300 m. (A). Mt. Candoon (Bukidnon), *Ramos & Edaño* 38738 ♀ (A, US). Kaatoan Chinchona (Bukidnon), *Britton* 439 ♀ 1,380 m. (L). Mt. Apo (Davao), *Elmer* 11463 s (A, BM, FI, K, L, NY, US, Z), *Clemens* 15675 j (A, NY), *Mearns & Hutchinson* 4679 s (L). Mt. KcKinley, *Kanehira* 2676 j (NY). **Celebes.** Mt. Wuka Tampai, Palu (Menado), *NIFS* bb15154 ♀ 2,500 m. (L). Parigi Lombok (Menado), *NIFS* bb15026 s 1,100 m. (L). Sawito (Enrekang), *NIFS* bb20782 s 1,750 m. (L). Mt. Tahole, Labu (Malili), *Burki* bb24089 ♀ 1,500 m. (L). Porehu (Malili), *NIFS* bb19564 ♀ 1,500 m. (A). Makale-Toloko (Manggala), *NIFS* bb20270 s 1,200 m. (A, L). **Moluccas.** Batjan, *de Haan* bb23236 s 2,199 m. (L). Obi, *de Haan* bb23812 s 700 m. (L). Buru, *NIFS* bb21509 s 800 m. (L), *Binnendyk* s.n. j (K, L). Middle Ceram, G. Sofia, *Stresemann* 133 s 2,200 m. (L). **New Guinea.** VOGELKOP: Mt. Nettoti, *van Royen* 3873 s 1,960 m. (L), *van Royen & Sleumer* 7403 s 1,750 m. (K, L), *Versteegh* BW 10407 s 1,700 m.

(L). Neentjapaki Mts., Kebar Valley, *Kalkman* BW 6373 s 1,090 m. (L). Adjar, Kebar Valley, *Koster* BW 6887 ♀ 1,110 m. (L). Tobie Mts., Kebar Valley, *Schram* BW 7972 s 720 m. (L). Anggi Lakes, *Gibbs* 5992 ♀ 7-9,000 ft. (BM, K), *Versteegh* BW 248 s 2,000 m. (A, K, L), BW 253 ♀ 2,100 m. (A, K, L), BW 281 s (A, L), *Kanehira & Hatusima* 13704 s (A), 14096 s (A), *Stefels* BW 2008 j 1,875 m. (L), BW 2010 s 1,860 m. (L), BW 2031 s 2,200 m. (L). Koebri Ridge, *Gibbs* 5657 s 8,500-9,000 ft. (BM, K). Ransiki, Sioriep, *Mangold* BW 2262 s 1,200 m. (K, L). Mt. Mundi (Ransiki), *Mangold* BW 2254 s 1,900 m. (L). WESTERN HALF: Mt. Genofa (E. of Arguni Bay), *Salverda* bb22564 s 750 m. (L), *Versteegh* BW 7596 ♀ 1,000 m. (L). Wissel Lakes, *Eyma* 4954 ♂ 1,750 m. (A, K, L), 5228 ♂ (A, K, L), 5371 ♀ (A, K, L), *Versteegh* BW 3009 ♀ 1,750 m. (A, L), *Johannes* BW 3262 s 1,750 m. (L), *Vink & Schram* BW 8764 ♀ 1,500 m. (L), BW 8945 s 1,850 m. (L). Nassau Mts., *Docters v. Leeuwen* 10906 s 2,600 m. (A, K, L). Mt. Doorman (Mamberamo R. Region), *Lam* 1628 ♀ 3,250 m. (L), 1647 ♀ 3,500 m. (L), 1742 ♀ 3,250 m. (L), 1984 s 2,560 m. (L). Lake Habbema, *Brass* 9058 ♂ 3,225 m. (A, BM, K, L), 9090 ♀ (A, BM, K, L), 10528 ♀ 2,800 m. (A, BM, K, L), *Brass & Meyer-Drees* 10432 ♀ 3,225 m. (A, L), *Brass & Versteegh* 10446 ♀ 2,840 m. (A, BM, L), 10446A ♂ 3,200 m. (A, BM, L). Barnhard Camp, *Brass & Versteegh* 11931 ♀ 1,850 m. (A, BM, K, L), 12523 s 1,100 m. (A, BM, L), 12523A ♀ 1,150 m. (A, K, L), 13520 ♀ 900 m. (A, BM, L), 13520A ♀ (A, L), *Brass* 12191 ♀ 2,100 m. (A, L). Cycloop Mts., *van Royen* 3721 s 1,560 m. (L), *van Royen & Sleumer s.n.* s 1,700 m. (L). Mt. Antares, Star Mts., *Kalkman* 4439 ♀ 2,360 m. (BM, L), 4539 ♀ 3,300 m. (L). TERR. NEW GUINEA: Lordberg (Sepik Region), *Ledermann* 9872 ♂ 1,000 m. (K, L-isotypes of *Phyllocladus major*). Wabag-Maramuni Road, *Saunders* 1025 s 10,000 ft. (L). Wankl (Mt. Hagen), *Hoogland & Pullen* 5871 s 7,600 ft. (A, BM, K, US). Mt. Wichmann, *Pulle* 982 s 2,500 m. (K, L), 1018 s (K, L), 1042 ♂ 3,100 m. (A, K, L). Upper Minj Valley, *Pullen* 273A j 9,000 ft. (A, L). Al River Mts. (Nondugl), *Womersley* NGF 5351 ♀ 7,000 ft. (A, BM, K, L). Mt. Kabanunt, Sirimbki, *Walker* ANU 859 ♀ 9-9,500 ft. (A, K, L), 859A j 9,500 ft. (A, K, L). Chimbu, *Cavanaugh* NGF 3333 ♀ (K). Waimambuno (Chimbu), *Saunders* 824 s 9,000 ft. (A, BM, K, L, US). Mt. Wilhelm, *Stauffer* 5651 s 2,600 m. (K, L, z). Lake Inim, *Flenley* ANU 2177 s 8,300 ft. (K, L). Ogeramngang, *Clemens* 4942 s 6-7,000 ft. (A, z), 5117A ♀ 6,000 ft. (A). Samanzing, *Clemens* 9384 ♂ 7-8,000 ft. (A), 9549 ♂ 8-9,000 ft. (A). Mt. Enggom, Sarawaket Range, *van Royen* NGF 16182 ♂ 11,000 ft. (K, L). Mannasat, Cromwell Mts., *Hoogland* 9482 ♀ 7,600 ft. (K). Bolan, *Lauterbach* 303 s 2,400-3,000 m. (BM). Mt. Kaindi (Bulolo), *Brass* 29692 ♀ 2,150 m. (A, K, L, NY, US), *Millar & Womersley* NGF 12255 s 7,000 ft. (A, K), *McVeagh* NGF 7580 ♀ 3,000 ft. (A, BM, K, L), *de Laubenfels* P481 ♂ 6,500 ft. (A, K, L, RSA, SBT), P481A j (A), *Toropai* NGF 17153 ♀ 6,900 ft. (K, L), *Havel & Kairo* NGF 17341 ♀ 7,000 ft. (K). Wau-Salamaua Road, *Millar* NGF 22785 ♀ 6,400 ft. (K). Mt. Amungwiwa, S. of Wau, *Womersley* NGF 17946 s 11,400 ft. (L). Wagau, Buang Region, *Womersley* NGF 17902 s 4,500 ft. (K, L). PAPUA: Mt. Giluwe, *Schodde* 2014 ♀ 8,800 ft. (K, L). Mt. Tafa (Cent. Div.), *Brass* 4035 s (A, NY). Murray Pass, Wharton Range, *Brass* 4578 s 2,840 m. (A, BM, NY), 4584 ♀ (A, K, L, NY, US). Mt. Obree, Owen Stanley Range, *Lane-Poole* (1923) s 7-9,000 ft. (A, K). Mt. Dayman, Maneau Range, *Brass* 22453 ♀ 2,230 m. (A). Mt. Maneao, *Crutwell* 519 s 7,500 ft. (K). Mt. Mon [Mau?], *Crutwell* 896 j 6,800 ft. (K). Mt. Vinevo, Goodenough, *Crutwell* 1423 s 7,000 ft. (K).

ILLUSTRATION. HOOKER, f. Icon. Pl. t. 889. 1852.



MAPS showing distribution of: 1, *Phyllocladus hypophyllus* Hooker f.; 2, *Dacrydium elatum* (Roxburgh) Wallich (dots west of line), *D. novo-guineense* Gibbs (dots east of line), *D. nausoriensis* de Laubenfels, known only from the Fiji Islands; 3, *D. pectinatum* de Laubenfels (dots west of line), *D. nidulum* de Laubenfels (dots east of line), *D. balansae* Brongniart & Gris, known throughout New Caledonia, and *D. cupressinum* Solander ex Lambert, known from New Zealand.

In addition to its completely disjunct distribution, *Phyllocladus hypophyllus* can be differentiated from all other species of the genus by its distinctly larger phylloclads. In other species the larger structures are deeply lobed and transitional to branch systems, those without deep lobes are less than 20 mm. wide or 25 mm. long. *Phyllocladus hypophyllus* is unique also in frequently having the seed cones terminal rather than lateral on the phylloclads, and in having peduncles on both pollen and seed cones up to twice the length observed in other species. The two species with intermediate sized phylloclads approaching the lower limit of those of *P. hypophyllus* are *P. glaucus* and *P. asplenifolius*, both of which share the glaucous habit with *P. hypophyllus*. The former has seed cones with numerous fertile scales and the latter has particularly small and nearly sessile pollen cones. The species *P. major* and *P. protractus* have been differentiated from *P. hypophyllus* on the basis of the shape of the cladodes, the position of the seed cone, and by their glaucous aspect. These differences, however, are found within local populations related to age of the tree or even on different parts of the same specimen.

Dacrydium Solander ex Lambert, Descr. Genus Pinus 1: Appendix 93.

1807. Type species: *Dacrydium cupressinum* Solander ex Lambert.

Lepidothamnus Phil. Linnaea 30: 730. 1860. Type species: *Lepidothamnus fonkii* Phil. [*Dacrydium fonkii* (Phil.) Benth.].

Shrubs and trees varying considerably in stature; juvenile leaves awl-shaped (falcate needles), longer than the adult, or in some species bifacially flattened and linear; adult leaves quite variable among the species from scale leaves to leaves resembling the juvenile needles and with either gradual or abrupt transitions uniting the different forms during their ontogeny; dioecious (or rarely monoecious in some New Zealand species); pollen cones cylindrical, terminal, or lateral and sessile, or both; seed cones much reduced, with bracts hardly modified from foliage leaves, often becoming fleshy when ripe, terminal, often on a short lateral branch; ovules inverted on bracts in a nearly terminal position and partly covered by an epimatium; seeds usually becoming erect, projecting well beyond the apex of the modified cone, occasionally occurring in pairs or three together, sometimes surrounded by the leaf-like extremities of the cone bracts, oval with the micropyle forming a small tip, usually somewhat flattened, on some species remaining inverted and covered by the fertile scale.

The genus *Dacrydium* occurs in a wide range of temperature and soil conditions but rarely in anything less than a very moist climate. It is readily divisible into two subgroups based on the internal morphology of the wood, leaves, and pollen (Tengnér, 1965). In one of the groups, called by Florin (1931) Group C, the adult leaves are more or less overlapping, broad, bluntly keeled scales (in one species, a prostrate alpine shrub, plants with juvenile type short flat leaves sometimes are fertile). The other group, called Group B, lacks scale leaves in all but two species where the scale is narrowly and sharply keeled and strongly appressed.

The seeds in this group always become more or less erect, while in Group C some species have inverted mature seeds covered by the fertile scale. Group C is entirely extra-tropical and will not be treated here. Group B is primarily tropical, the two groups overlapping in New Zealand where most of the Group C species are found. In Group B the juvenile leaves are scarcely distinguishable between the various species, being lanceolate, slender, and bifacially flattened on the seedling but soon becoming strongly keeled and awl-shaped. For the most part, the seeds are also very similar throughout, so that the species are distinguished primarily by the form of the seed and pollen cones, and by the adult leaf form. Four common leaf types occur, one with fairly short needles (2–5 mm.) changing gradually from the juvenile form (*cupressinum*, *balansae*, *nidulum*, *pectinatum*), a longer type with more flexible needles (*beccarii*), a type with narrow, flat, and lanceolate leaves (*xanthandrum*), and one with scale leaves changing abruptly from the juvenile needles (*elatum*, *novo-guineense*). In addition, there are a number of local species, usually with distinctly bifacially flattened leaves and, in most cases, rather rare. Most of the species are too small in growth form or are too rare to be useful, but a few, as *D. cupressinum*, are valuable lumber trees.

KEY TO THE SPECIES OF DACRYDIUM

1. Trees or prostrate shrubs with adult leaves broad, imbricate, bluntly keeled scales (Group C).
1. Trees or bushes with adult leaves narrow, appressed, sharply keeled scales or longer spreading leaves (Group B).
 2. Abrupt change between juvenile and adult leaves, which are minute (not more than 1.5 mm. long).
 3. Bracts in the fertile area similar to scale-like foliage leaves. 2. *D. elatum*.
 3. Bracts in the fertile area distinctly longer than the foliage leaves or scales.
 4. Seeds and pollen cones not small; foliage leaves scale-like. 3. *D. novo-guineense*.
 4. Seeds and pollen cones small; foliage leaves spreading. 4. *D. nausoriense*.
 2. Gradual change from juvenile to adult leaves, which are at least 2 mm. long.
 5. Bracts in the fertile area not surpassing the epimatium and not longer than the foliage leaves.
 6. Microsporophylls narrowly lanceolate; leaves thick (0.6 mm.) straight. (*D. cupressinum*).
 6. Microsporophylls long triangular; leaves less than 0.4 mm. thick, curved upwards at the tip.
 7. Slender, linear leaves with the tip turned upwards. 5a. *D. pectinatum* var. *pectinatum*.
 7. Thick, sharply tapering and spreading leaves. 5b. *D. pectinatum* var. *robustum*.
 5. Bracts in the fertile area distinctly longer than the epimatium and, where the foliage leaves are not long, distinctly elongated by contrast.

8. Bracts in the fertile area distinctly longer than the foliage leaves of the subtending branch; microsporophyll triangular.
9. Bracts, in the fertile area, and foliage leaves strongly keeled, triangular or quadrangular in cross section.
10. Developing seed extending well beyond the elongated bracts of the fertile area; foliage leaves not more than 0.8 mm. wide.
11. Leaves approximately as thick as wide, tip more or less blunt and not incurved. 6a. *D. nidulum* var. *nidulum*.
11. Leaves noticeably wider than thick, tip distinctly armed with a slight prickle, generally incurved and crowded. 6b. *D. nidulum* var. *araucarioides*.
10. Developing seed completely surrounded by elongated bracts, the tip protruding slightly on maturity; foliage leaves robust, more than 1.0 mm. wide.
12. Pollen cones 2.0 mm. in diameter; leaves curved upwards but not inwards, markedly tapering, quadrangular in cross section. 7. *D. balansae*.
12. Pollen cones 2.5–3.0 mm. in diameter; leaves strongly incurved, linear, axial surface concave towards the apex. 8. *D. araucarioides*.
9. Bracts in the fertile area and foliage leaves distinctly flat, more than twice as wide as thick.
13. Seed and pollen cone small; leaves lanceolate, 3–4.5 mm. long. 9. *D. lycopodioides*.
13. Seed and pollen cone not small; leaves linear, 4–7 mm. long. 10. *D. spathoides*.
8. Bracts in the fertile area no longer than the foliage leaves of the subtending branch; microsporophylls elongated, lanceolate.
14. Fertile bract not surpassing the mature seed, leaves 5–10 mm. long.
15. Pollen cone 20–25 mm. long by 5–7 mm. in diameter; leaves less than 0.8 mm. wide.
16. Seed cone terminal on ordinary foliage branches; mature seed surrounded by bracts. 11. *D. magnum*.
16. Seed cone terminal on shoots with reduced leaves; seed well exposed when mature.
17. Leaves quadrangular or triangular in cross section, imbricate.
18. Leaves uniform, more than 5 mm. long, at least ten times as long as wide.
19. Leaves spreading outward. 12a. *D. beccarii* var. *beccarii*.
19. Leaves incurved and compact. 12c. *D. beccarii* var. *rudens*.
18. Leaves variable, sometimes less than 5 mm. long, less than eight times as long as wide. 12b. *D. beccarii* var. *subelatum*.
17. Leaves twice as wide as thick, spreading at nearly right angles to the stem. 13. *D. xanthandrum*.

15. Pollen cone 20–25 mm. long by 5–7 mm. in diameter; leaves at least 1.0 mm. wide. 14. *D. gibbsiae*.
 14. Fertile bract much longer than the seed, leaves 12–20 mm. long.
 20. Leaves quadrangular in cross section, linear.
 15. *D. guillauminii*.
 20. Leaves flat, lanceolate. 16. *D. comosum*.

2. *Dacrydium elatum* (Roxburgh) Wallich, London Jour. Bot. 2: 144. 1843.²

Juniperus elata Roxburgh, Fl. Indica 3: 838. 1832. Lectotype: Wallich 6045, Malay, Penang.

Dacrydium junghuhnii Miquel, Pl. Junghuhn, 1: 4. 1851. Type: Junghuhn s.n., Sumatra.

Dacrydium pierrei Hickel, Bull. Soc. Dendr. France 76: 74. 1930. Lectotype: Pierre 1396, Cochin China, Phu Quoc Island.³

Tree to 40 m., much branched with masses of erect twigs forming a dome-like crown; bark furrowed and flaky, reddish-brown, inner bark pink; juvenile leaves acicular, to at least 12 mm. long, gradually becoming shorter and more robust before changing abruptly on young trees, about 6–8 mm. long, sharply keeled on four sides and nearly straight, spreading, acute; mature foliage branches cord-like, 1–2 mm. in diam., covered with imbricate scales which are acute and sharply keeled, 1–1.5 mm. long by 0.4–0.6 mm. wide, occasionally passing through a semi-adult or transitional stage of short spreading leaves about 1.5 mm. long; branches with juvenile leaves occasionally fertile; pollen cones terminal, usually on short lateral branches, thus sometimes almost lateral, cylindrical, 4–5 mm. long and 1.2 mm. wide; microsporophylls triangular, acute; seed cone terminal, generally on short lateral branches, bracts of the cone becoming slightly enlarged, red and fleshy when mature; the solitary naked seed becomes almost erect, tapering to a blunt apex, reaching 4–4.5 mm. in length.

DISTRIBUTION. In humid mountain forests from north central Thailand and Tonkin to central Sumatra and Sarawak, from 500 to 1,700 meters in elevation or even down to sea level where suitable conditions exist. MAP 2.

Thailand. NORTH CENTRAL: Loei, Phu Krading, Tham Nam, Royal Forest Dept. 3631 j, 1,045 m. (US), Kerr 8727 j (K), 8727A ♀ (K), 8727B ♂ (K), Larsen 2263 j 1,300 m. (A). Without loc., Smitinand 19058 j 1,200 m. (K). CENTRAL: Nakhaun Nayok, Phengkhlai 691 ♂, j (K, L). Cambodia. Plateau overlooking Gulf of Siam, Showe (1927) s, j 3,000 ft. (BM). North of Kampot, Poilane 14707 ♀ (NY). Near Komplon (Phnom Penh), Bejoud 717 ♀ (ILL). Without loc., Pierre 19074 s (K). Tonkin. Than Moi, Balansa 596 ♂, j (ILL, K). Annam. Summit Mt. Bani, near Da Nang, Clemens 4280 j (K, NY, US). Bana, near Tourane, Poilane 1539 s, j 1,200 m. (NY-syntype of *D. pierrei*), 7095 ♀ (A-

² Species are numbered consecutively through the whole paper.

³ Hickel did not specify a type, but listed many specimens of which Balansa 576 is the first. The one specimen collected by Pierre is here chosen as the lectotype because of the specific epithet.

syntype of *D. pierrei*). Kontum Prov., *Poilane* 33351 s 1,200 m. (ILL). Nha-trang, *Poilane* 25 j (A-syntype of *D. pierrei*), 3455 ♀ (A-syntype of *D. pierrei*), 3782 ♀ (A, K-syntypes of *D. pierrei*), 4411 ♀ (A-syntype of *D. pierrei*). **Cochin China.** Phu Quoc Island, Gulf of Siam, *Pierre* 1396 ♂, j (A, K, NY-isotypes of *D. pierrei*), *Harmand* (*Godefroy*) 901 ♂ (A-syntype of *D. pierrei*). Without loc., *Poilane* 32825 ♂ (ILL), *Godefroy-Lebeuf* s.n. ♂ (K). **Malaya.** Thailand border (Botong), G. Ina, *Kerr* 7554 s, j (K). Penang, *Wallich* 6045 s (BM-lectotype of *Juniperus elata*; K-isotype), *Sinclair* 39094 s, j (K, L), *Walker* 70 j (K), *Maingay* 2262 s (K), 2753 s (K), *Curtis* 2880 s, j (K). Perak, *Ernst* 1213 s, j (z). G. Butu, *Wray* 1028 j (K), 3899 s, j (K). Pahang, G. Tahan, *Haniff & Nur* s.n. ♂ (K), *SFN* 7959 s, j 5,500 ft. (A, K), *Wray & Robinson* 5354 s 3,300 ft. (K), 5380 j (K). Pahang, G. Lesong, *Wakau* 4155 j (K). Ja-hore, Mt. Ophir, *Maingay* 1503 ♀ (FI, GH, K, L), *Moxon* s.n. s (L). **Sumatra.** Between Tapanuli and Silindong, *Junghuhn* s.n. j 2,000 ft. (L-holotype of *D. junghuhnii*). Pajakumbuh, W. Taram, *Meijer* 6938 ♂, j 500–1,000 m. (K, L), 7040 ♀ (L). Poya Kombo, *Teysmann* 21647 ♂ (K), s.n. s (K). Without loc., *Praetorius* s.n. j (L). **Sarawak.** Merurong Plateau (Bintulu), *Brunig* S9991 s 750 m. (L). Mt. Dulit, *Richards* 1962 s 1,250 m. (BRI, K, L, US). Between Biak R. and Sut, *Pickles* 2991 ♂ 2,360 ft. (L, US). Lawas, *Brunig* S10673 ♂, j 900 m. (L). **Borneo.** Without loc., *De Vriese* s.n. j (L).

ILLUSTRATIONS. RIDLEY, H. N. Fl. Malay Peninsula t. 227. 1925. CORNER, E. J. H. Gard. Bull. Straits Settlements 10: t. 5. 1939.

Dacrydium elatum differs from *D. novo-guineense* in the form of the female cone, in the form of the juvenile leaves, size of the pollen cone, size of the mature tree, and in its occurrence generally at lower elevation. Specimens of *D. pectinatum* have been much confused with *D. elatum* because the *pectinatum* foliage is similar to the juvenile foliage of *D. elatum* but, the leaves of *D. pectinatum* are, in fact, shorter and distinctly curved. The known range of these two species overlaps only in Sarawak. The name *elatum* has further been applied to almost any uncertain *Dacrydium* specimen from Borneo to the Fiji Islands. Hickel described *D. pierrei*, contrasting it with *D. beccarii*, which he mistook for *D. elatum*.

3. *Dacrydium novo-guineense* Gibbs, Contrib. Phytogeography and Flora of the Arfak Mountains 78. 1917. Lectotype: Gibbs 5648, New Guinea, Arfak Mountains.

Tree to about 10 m. with branches rigidly ascending into a rounded crown; juvenile leaves acicular, spreading and incurved, lanceolate, acute, keeled on the back, to 7 mm. long by 0.7 mm. wide but variable in size, changing abruptly to the adult form, occasionally passing through a semi-adult or transitional stage of short spreading leaves about 1.0–1.5 mm. long; mature foliage in imbricate scales, acute and sharply keeled, 1.0–1.5 mm. long by 0.4–0.6 mm. wide; foliage branches 1.0–2.0 mm. in diameter, penultimate branches becoming larger; pollen cones terminal, usually on short erect lateral branches, cylindrical, 8 mm. long, microsporophylls triangular; seed cones terminal on short curved lateral branches, bracts long and spreading, reaching 3 mm. at the cone apex,

the whole cone becoming red and fleshy when mature, the single apical seed becoming almost erect and extending well beyond the cone bracts, 5 mm. long, edges slightly keeled, tapering to a small blunt apex.

DISTRIBUTION. In open to mossy forests, often on ridge tops from 1,300 to 2,750 meters in elevation, occasionally lower. Locally common but apparently localized; from Obi and the mountains of western New Guinea at least as far as the Western Highlands of the Territory of New Guinea. The collections from the Celebes are tentatively included here until it can be determined whether these represent *Dacrydium elatum* or *D. novo-guineense*. MAP 2.

Celebes. Manado, Poso, *Eyma* 1623 s 1,700–1,800 m. (L), 3642 ♂ (L). Masamba, Kuniapu, *NIFS* bb24964 s 1,500 m. (L). Masamba, Omboan, *NIFS* bb26288 j 1,800 m. (L). Enrekang, *NIFS* bb20786 j 1,900 m. (L). **Moluccas.** NW. Buru, *Stresemann* 395 s, j 1,800–2,000 m. (L). Buru, *Martin* s.n. j (L). Obi, *de Haan* bb23813 s 700 m. (L), bb23814 s, j (L). **New Guinea.** **VOGELKOP:** Tamrau Mts., *Van Royen & Sleumer* 7219 s, j 2,000 m. (L). Kebar Valley, *Van Royen* 3857 s, j 1,980 m. (L). W. of Mt. Nettoti, *Van Royen & Sleumer* 7948 ♀ 2,100 m. (K, L, LAE), 7948B j (L). Arfak Mts., *Gibbs* 5648 ♀ 9,000 ft. (BM-lectotype; K-isotype), 5508 s, j 7,000 ft. (BM, K-syntypes), *Kanehira & Hatusima* 13518 s 2,000 m. (A), *Gjellerup* 1032 s, j 1,800 m. (L). Anggi Lakes, *Versteegh* 256 ♀ 2,100 m. (L), 262 ♀ (L), 269 ♂ (L), *Stefels* BW 2015 j 1,860 m. (L), BW 2033 s, j 2,100 m. (L). **WESTERN HALF:** Wissel Lakes, *Eyma* 4422 s, j 1,750 m. (A, K, L), 4519 ♀ 1,760 m. (A, K, L), *Vink & Schram* BW 8746 s 1,820 m. (L). Hellwig Mts., *Pulle* 663 ♀ 1,300 m. (L), 966 s 2,600 m. (K, L). Barnhard Camp, *Brass & Versteegh* 11967 ♂ 1,520 m. (A, BRI, K, L), 12507 j 2,100 m. (A, BRI, L). **TERRITORY OF NEW GUINEA:** Western Highlands, Mt. Hagen, *Cavenaugh* NGF 3337 s, j (A, BRI, L). Tagen R., Jimmi Valley, *Womersley & Millar* NGF 7680 ♀ 4,300 ft. (A, BRI). Minj-Jimmi Divide, *Robbins* 598 ♂, j 6,500 ft. (A, BRI, K, L, US). Nondugl, *Womersley* NGF 4420 ♀, j (A, BRI, K, L). **PAPUA:** Sibium Range, *Pullen* 5930A j (L).

ILLUSTRATION. GIBBS, L. S. Contrib. Phytogeography and Flora of the Arfak Mountains, t. 3. 1917.

Being one of the scale-leaved species of *Dacrydium*, *D. novo-guineense* cannot be distinguished in the sterile form from *D. elatum* from which it differs in the elongated bracts of the seed cone and to a lesser extent in the form of the juvenile leaves and the size of the pollen cone. Juvenile specimens can often be separated from *D. beccarii*, with whose range it overlaps, by their coarser and less dense growth. From *D. nidulum* the juvenile leaves differ in their variable size including, for the most part, greater length. The rapid change from juvenile to adult form is so striking and comes when the tree is yet quite small so that collectors generally include mature leaf forms when dealing with *D. novo-guineense*. The rigid ascending branches are another distinctive character.

4. *Dacrydium nausoriensis* de Laubenfels, sp. nov.

Arbor ad 25 m. alta, ramosissima. Folia plantarum iuvenilis acicularia, ad 9 mm. longa, ad formam adultam abrupte convertentes; folia plantarum

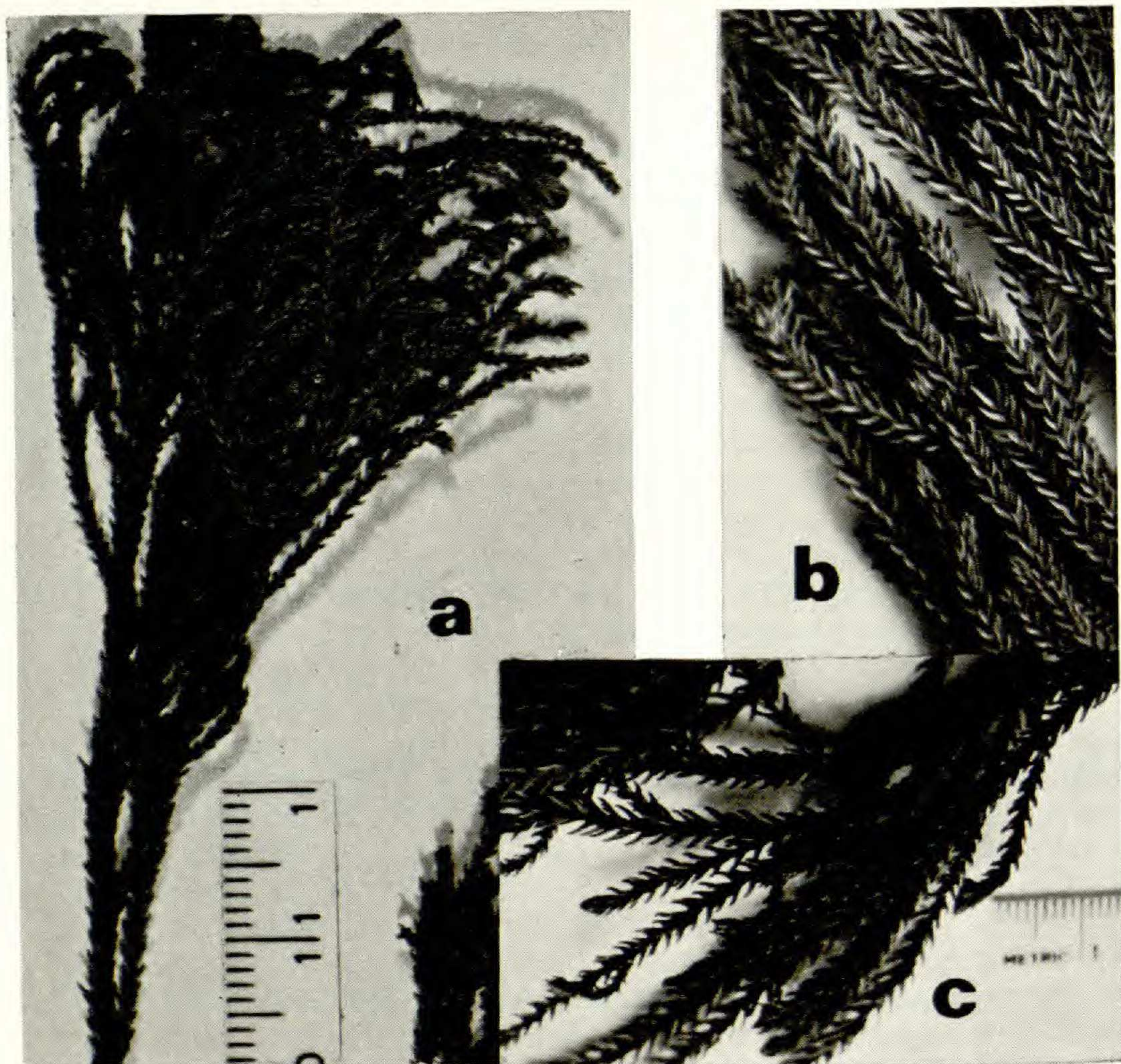


FIGURE 1. a, *Dacrydium nausoriensis* de Laubenfels, portion of the holotype, *de Laubenfels P302* (A), enlarged; b, *D. pectinatum* de Laubenfels var. *pectinatum*, portion of the isotype, *Nicholson SAN 17292* (L), enlarged; c, *D. pectinatum*, var. *robustum* de Laubenfels, portion of the holotype, *Meijer SAN 37908* (L), enlarged; b and c are at same magnification.

adultarum parva, patula, acuta, dorsaliter carinata, densa, 1 mm. longa, 0.4 mm. lata. Strobili masculi cylindranei, terminales vel laterales, saepe utroque, parvi (?), ad 2.5 mm. longi. Strobili feminei ad apicem ramulorum saepe brevi; folia ad basem seminis longiora, ad 2 mm. longa; semen protrudendum, 3.5–4 mm. longum. Holotypus: *de Laubenfels P302* (A), Fiji, Nausori Highlands. FIG. 1a.

DISTRIBUTION. In slightly open forest on the leeward sides of the large islands of Fiji and apparently of limited extent.

Fiji. VITI LEVU: Nausori Highlands, *de Laubenfels P302* ♀ 1,900 ft. (A-holotype; K, RSA, SBT-isotypes), *P303* j (A, RSA, SBT), *P304* ♂ (A, RSA, SBT), *Damanu NH19* ♀ (K), *NH23* ♀ (K), *Johns 2* ♀ (K), *Kuruvoli 13326* ♀ (K). VANUA LEVU: Lambassa, Sarava, *Damanu L14* s (K), *Anon. FD832* ♀ 400 ft. (K).

The species of *Dacrydium* with sharp scale-leaves, changing abruptly from juvenile to adult form (*D. elatum* and *D. novo-guineense*) stand apart from the other species, with *D. nausoriensis* representing a somewhat transitional position. The abrupt change from fine juvenile needles to the more robust and very short adult leaves is in accord with the scale-leaved species, while the still spreading orientation is the common condition for other species. Occasional specimens of *D. elatum* and of *D. novo-guineense* have transitional leaves abruptly marked off from the juvenile leaves and closely resembling the adult leaves of *D. nausoriensis*. The bark of this new species is virtually the same as in all other species of the group, with large thick flakes, fibrous and brown within but with a tough smooth surface generally well supplied with lenticels and weathering gray. The seeds are also of the usual type showing a slight marginal keel and becoming a rich brown color. The pollen cones seen may not be fully grown.

5. *Dacrydium pectinatum* de Laubenfels, sp. nov.

Arbor ad 40 m. alta, ramosissima; cortex canus vel rufulus; folia brevia, oblique adscendentia, patentia pectinatum, apice paulo incurva, dorsus carinata, 2–5 mm. longa, 0.4–0.8 mm. lata (juvenilis ad 20 mm. longa). Strobili masculi cylindranei, terminales, 9–12 mm. longi, 2 mm. lati. Strobili feminei ad apicem ramulorum, saepe ramulorum brevium; folia ad basis parviora; folia strobilorum sub semine maturo parva, crescentes carnosae rubrae; 1–2 folia ultima fertilia. Semen 4.5 mm. longum, non tegens foliis strobilorum. Holotypus: *Nicholson SAN 17292* (A), North Borneo, Sandakan. FIGS. 1b and 2.

The short bracts in the fertile area not even surpassing the epimatium and not longer than the foliage leaves, distinguish this new species from all but two others, one of which, *Dacrydium elatum* has distinctly smaller pollen cones and scale-like foliage leaves abruptly marked off from the juvenile leaves, while the second, *D. cupressinum*, has very elongated microsporophylls and thick straight stubby foliage leaves. The short spreading needles distinguish sterile specimens of *D. pectinatum* from other species with which its range overlaps. Two varieties have been recognized because of rather marked differences in leaf form.

5a. Var. *pectinatum*.

Folia gracilia, linearia, acicularia, 2–5 mm. longa, 0.4–0.6 mm. lata.

DISTRIBUTION. From Hainan through the Philippines to Billiton Island, at low elevations up to 1,500 meters but mostly below 600 meters. Several specimens are reported from sandy soils. MAP 3.

Hainan. Yaichow, *Liang 62041* s (NY), *62619* j (NY), *62670* ♀ (NY, US), *63214* s top of mt. (A, NY, US). Hung Mo Mt., *Tsang & Fung LU18100* ♀ (A, NY), *LU18152* ♀ (A, NY), *McClure 18303* j 1,000–1,500 m. (NY). Po-ting, *How 72869* ♀ (A). Five Finger Mt., *Chun 1367* j (A), *2089* s (A). Dai Land, *Dung Ka, Chun & Tso 4380* 2,400 ft. (A, NY). Chim Fung Mt., *Lau 5283* ♂ (A).

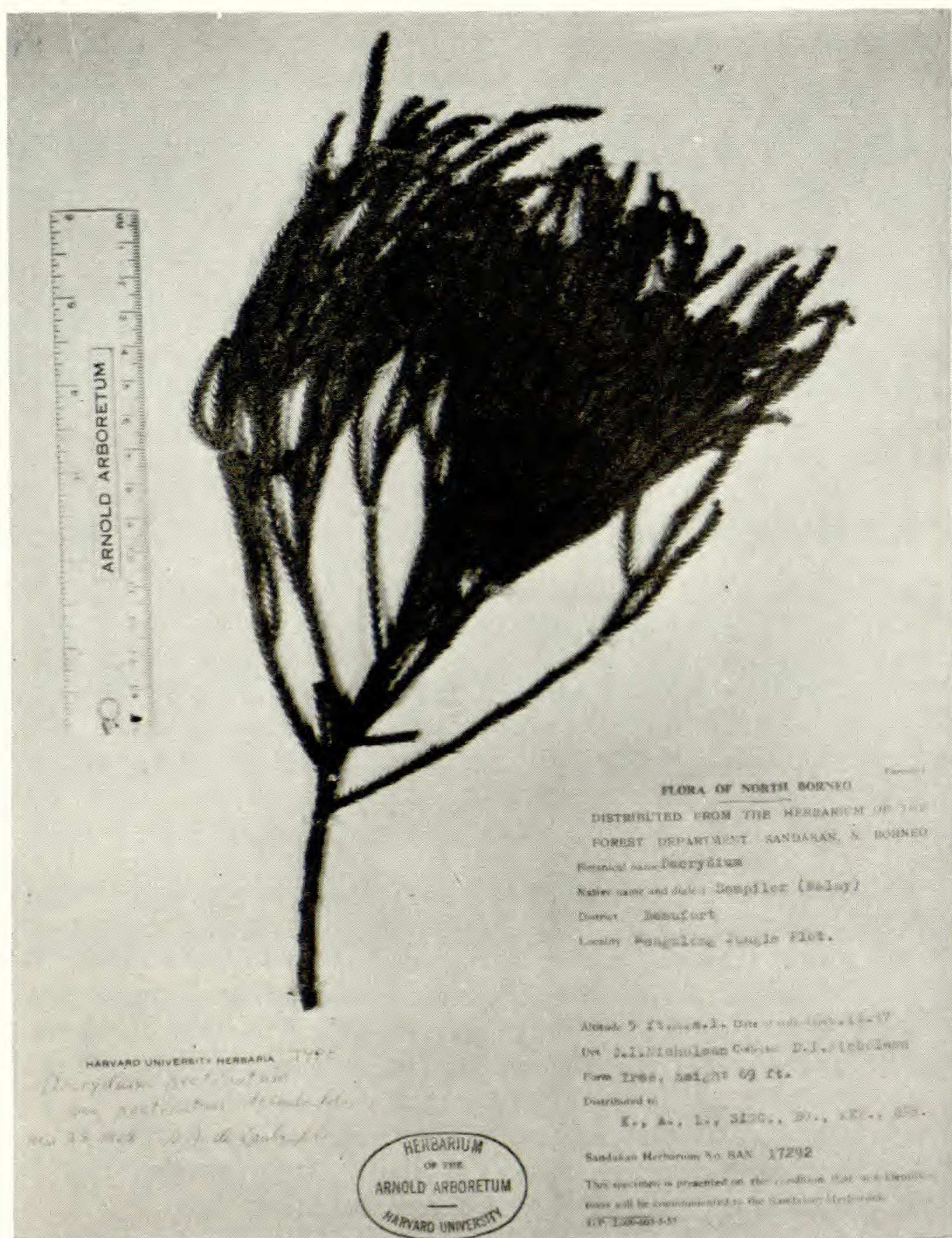


FIGURE 2. *Dacrydium pectinatum* de Laubenfels var. *pectinatum*, photograph of the holotype, Nicholson SAN 17292 (A).

Without loc., How & Chun 70144 ♀ 2,000 ft. (A, NY, US), Liang 63693 ♂ (NY, US), 65094 ♂ (A, NY), Wang 33651 s (A, NY), 36532 ♂ (A, NY), Tang 457 ♀ (A), Hance 22162 j (BM). Billiton. NIFS bb32284 ♀ (A, L), Rossum 122 ♀ (L), 784 ♀ (L). Sarawak. Bako National Park (20 miles NE. of Kuching), Purseglove P5066 j 400 ft. (K, L), P5553 ♂ 350 ft. (K, L, NY), Brunig S12073 ♂ 120 m. (L), S12074 s 130 m. (L), Sinclair & Kadim 10318 s (A, K, L), Sing JC/59 s 300 ft. (K), Rashid S9546 s 400 ft. (L), Nicholson 1319 s 200-300 ft. (US). Limbang, Brunig S1101 ♀ 1,400 ft. (K, L). Kuching, Beccari 643 j (FI, K), 644 ♀ (A, F, K). Mt. Mattang, Beccari 2626 ♀ (FI, K), 3119 ♂ (FI). Brunei. Ashton

BRUN 5024 s (K, L). **North Borneo.** Ranau, *Meijer* SAN 20951 j 3–4,000 ft. (L). SAN 20952 s 4,000 ft. (L), SAN 20970 s 4,200 ft. (K, L). Sipitang, *Cuadra* A3291 s (A, BRI, K, L), *Erdtman* SAN 22643 s (K), *Meijer* SAN 21854 j (L). Beaufort Dist., Sandakan, *Nicholson* SAN 17292 ♀ 5 ft. (A-holotype; BRI, L-isotypes). Beaufort, *Cuadra* A1329 s (K), *Singh* SAN 24336 s (K). Mt. Melian near Kiabau Labuk (Sandakan), *Meijer* 51586 j 2,500 ft. (L). Bulungan, *Kostermans* 9274 s (BRI, L). Without loc., *Cuadra* A1348 s 400 ft. (K), *Melegrito* 1575 ♀ (K), *Camber* 4009 ♂ 1,500 ft. (K), 4010 ♀ (K), 4011 j (K). **Borneo.** Singkawang, *NIFS* bb3903 ♂ 5 m. (L), *Sulaiman* 2 s (K, L). Masaran, *NIFS* bb19869 ♂ 40 m. (L), bb19870 j (L). Karimata Arch., *Teysmann* 11599 s (L), *Mondi* 182 s (K, L). Sampit, *Buwalda* 57 (bb32434) ♂ 3 m. (L), *NIFS* bb33046 ♂ 9 m. (L). Upper Mahakam, Taliba, *NIFS* bb26589 s 600 m. (A, L). Muartewe, middle Barito R., *NIFS* bb27736 s (L), bb28751 s (A, L), bb28752 j (A, L), bb28753 j (A, L), bb28754 ♀ (A, L). Kenpai, *Hallier* 1422 j (L, NY), 2164 j (L, NY), *Teysmann* 8617 j (L). G. Klam, *Hallier* 2360 ♂ (K, L, NY), 2374 s (L, NY). Samarinda, *Posthumus* 2175 j (K, L). W. Kutei, *Endert* 1604 j 20 m. (L). W. Kutei, Mt. Palimasan, *Kostermans* 12782 j (L). Karran, *Müller* s.n. s, j (L). Without loc. *Korthals* 1863 s (K), *Beccari* s.n. s (L). **Philippines.** Palawan, Mt. Gantung, *Edaño* 77619 s (NY). Mindoro, *Merritt* 8527 j (US), 8528 j (NY, US). **MINDANAO:** *Ramos & Pascasio* 34497 j (A); Mt. Malindang, *Morao* 6010 ♀ 1,200–1,400 m. (A); Monica (Zamboanga), *Pascua* 15692 j 1,000 m. (L).

ILLUSTRATIONS. BLUME, C. L. *Rumphia* 3: t. 172B, fig. 1, t. 172C, fig. 2. 1849, as *Dacrydium elatum*.

The slender leaves of this variety, with more or less parallel margins, distinguish it from variety *robustum* which, in addition, grows in wet places. Variety *pectinatum* has foliage which is essentially identical to that of *D. nidulum* var. *nidulum*, although the majority of the specimens have leaves less than 3 mm. long, whereas *D. nidulum* only occasionally has such short leaves. The form of the seed-bearing structure is the important specific distinction. The bark is brown with loose scaly flakes. The four species, *D. cupressinum*, *D. balansae*, *D. nidulum*, and *D. pectinatum* must be considered a series of closely related species that are separated geographically.

5b. Var. *robustum* de Laubenfels, var. nov.

Folia robusta, apicem versus angusta, cuneata, 2–3 mm. longa, 0.6–0.8 mm. lata, basis 0.6–1.0 mm. crassa. Holotypus: *Meijer* SAN 37908 (L), North Borneo, Mt. Silam. FIG. 1c.

DISTRIBUTION. The island of Borneo in mossy forest and in peat swamps, from low elevation to 850 meters.

Sarawak. Kuching, *Omar* SFN 376 s (LAE). Lawas, Keyangeran, *Tagei* 1795 ♂ 12 ft. (K, L). Without loc., *Spurway* 376 s (K). **Brunei.** W. Kayangeran F. R., *Brunig* 1006 ♂ (K, L). **North Borneo.** Weston, *Mikil* SAN 31985 j (K, L). Mt. Silam, Lahad Datu, *Meijer* SAN 37908 ♀ 2,500 ft. (K-isotype; L-holotype), *Wood* SAN 4172 ♂, j 2,500 ft. (BRI, K, L). Sipitang, *Charington* SAN 22299 ♀ 10–25 ft. (L).

The short, spreading, and sharply tapering leaves of this variety give it a distinctive appearance that sets it apart from related taxa. There is often a whitish deposit on the branches. The bark is reddish gray, fissured, and scaly.

6. *Dacrydium nidulum* de Laubenfels, sp. nov.

Arbor ad 30 m. alta, ramosissima; folia brevia, linearia, oblique adscendentia, dorsaliter carinata, 2–5 mm. longa, 0.4–0.8 mm. lata. Strobili masculi cylindranei, terminales, 9–12 mm. longi, 2 mm. lati. Strobili feminei ad apicem ramulorum, saepe ramulorum brevium; folia ramulorum fertilium parviora sed folia ad apicem longiora semen cingendum niduliformum; apex seminis maturis protrudendus; 1–2 folia ultima fertilia. Semen 3.5–4 mm. longum. Holotypus: *Vink BW 15271* (L), New Guinea, Vogelkop. FIG. 3a.

The widespread specimens of this new species have usually been carelessly labelled *Dacrydium elatum* which, in the mature form, is quite distinct, although (as is also true of *D. novo-guineense*) the juvenile leaves of *D. elatum* are similar in shape, and range in size from equal to longer. *D. nidulum* differs from most species in the bracts of the fertile structure which, as they grow on the end of a fertile shoot, whose leaves are often shorter than the usual foliage leaves, are considerably elongated, clasping the growing seed in a protective nest. As the seed grows and becomes almost erect, it protrudes well beyond the tips of its cluster of bracts. Other species with similarly elongated bracts in the fertile area include *D. lycopodioides* and *D. nausoriensis*, whose bracts are distinctly flattened and whose pollen cones are distinctly smaller, *D. spathoides* also with flattened bracts and with flat linear leaves, and *D. novo-guineense* with scale-like foliage leaves.

A wide variety of forest conditions is tolerated by *D. nidulum* from peaty swamps and wet primary forest to light secondary forest, but always in very moist climatic conditions or with a high ground water-table. The feathery seedling leaves gradually shorten and change in form to the adult type. The brown bark exfoliates in thin sheets or rough plates. As might be expected over so large a range, there is some variation in form, particularly in the size of the leaf. Two varieties have been recognized on the basis of contrasting leaf forms and a slight difference in the microsporophylls.

6a. Var. *nidulum*.

Folia non conferta, patula, acicularia; apice paulo incurva, obtusa. Squama strobilorum masculorum triangularia, imbricata, apice elongata.

DISTRIBUTION. From Celebes to Fiji, and particularly in the western part of New Guinea from near sea level to 1,800 meters (most collections are below 1,000 meters), and in wet rainforest areas. MAP 3.

Celebes. Masamba, *Steup bb23045* j 1,700 m. (K, L). Lasurume R. (SE.), *El-*

bert 3126 j 250–755 m. (L). Sawankudu R. (SE.), *Elbert* 3726 j 150–497 m. (A). Lampia (Malili), *NIFS* bb19709 s (A, L). Taparan-masapi (Malili), *NIFS* bb20535 s 434 m. (A, L). Moluccas. Halmahera, *NIFS* bb24934 ♀ 450 m. (A, BRI, L), *Nedi* 301 j 600 m. (L). New Guinea. VOGELKOP: Segior (L. Ajamaru), *Vink* BW 15271 ♀ 220 m. (L-holotype; K, LAE, z-isotypes). Tehach (L. Ajamaru), *Versteegh* BW 7378 ♀ 250–300 m. (L). Ajamaru, *Versteegh* BW 4985 s 275 m. (L), *Vink* BW 15249 s 240 m. (L, z). Tobi Mts. (Kebur Valley), *Versteegh & Kalkman* BW 5594 ♀ 900 m. (L, LAE), *Sijde* BW 5596 s 900 m. (L). Kebur Valley, *Koster* BW 6885 ♀ 1,100 m. (L). JAPEN IS.: Aisau, *Iwanggin* BW 9225 ♂ 210 m. (K, L, LAE). Mariattu, *NIFS* bb30321 j 800 m. (A, L), bb30475 s 500 m. (A, L). Without loc., *NIFS* bb14390 j 150 m. (L). N.W. NEW GUINEA: Rouffaer R., *Leeuwen* 10280 s 250 m. (A, K, L). Sidoarsi Mts., *Schram* BW 9271 s 660 m. (L). Bodem R., *Lans* BW 2373 j 99 m. (L, LAE). Dalman, 45 km. inland from Nabire, *Kanehira & Hatusima* 12324 s 400 m. (A). CYCLOOP MTS.: *Versteegh* BW 4754 ♀ 120 m. (L, LAE), *Van Royen & Sleumer* 6246 ♂ 750 m. (K, L, LAE, z), *Koster* BW 235 s 80 m. (L), BW 239 s 80 m. (A, K, L), BW 1182 ♀ 50 m. (A, K, L), *Brass* 8806 s 20–100 m. (A, BRI, L). CENTRAL NEW GUINEA: Weta-batie, *Mangold* BW 667 s 205 m. (L). Upper Digul, *NIFS* bb14519 ♂ 15 m. (K, L). Digul R., *Versteegh* BW 4891 ♀ cultivated by natives (L, LAE). TERR. NEW GUINEA: Sattleburg, *Clemens* 7954 ♀ (A), 7954A j (A), 7907B j (A). WESTERN DIVISION, PAPUA: Oriomo R., *Brass* 5875 ♂ 10–20 m. (A, K, L, NY, US), 5876 ♀ (A, K, L, NA, NY, US), 5876A j (A, L, NY, US), *Hart* 5021 s (A, BRI, K, L, US), *White & Gray* NGF 10407 ♂, j 70 ft. (BRI). EAST PAPUA: Betw. coast and Owen Stanley Mt., *Burke* 377 ♂ (K). N. of Mapo (Milne Bay), *Smith* NGF 1352 s 2,700 ft. (BRI, L, LAE). Normanby I., *Brass* 25573 ♂ (A, K, L, US), 25482 j (A, L). Fiji. VITI LEVU: Reservoir Road, *de Laubenfels* P312 j (A, K, RSA, SBT), P312a j (A, K, RSA, SBT), P313 j (A, K, RSA, SBT), P315 ♂ 300 ft. (A, RSA, SBT), *Tothill* 854 s (K). Naitasiri, *Gillespie* 2142 j 150 m. (K, NY, US). Namboutini, *Anon.* FD834 s (K), *de Laubenfels* P308 s 1,000 ft. (A, RSA, SBT), P307 j (A, RSA, SBT). Mt. Korumbamba, *Meebold* 16529 j summit (K). Near Burreata, *Milne* 55 ♂ (K). Mawata, *Kuruvoli & Parham* 13433 s (K). Nandarivatu, *A. C. Smith* 6244 s 1,250 m. (A, BRI, ILL, K, US). Mt. Nomama–Mt. Tomanivi, *A. C. Smith* 5734 j 1,050 m. (ILL.). Without loc., *Storck* 906 ♀ (A, K), *Seemann* 573 j (K), *Horne* 613 ♀ (K). VANUA LEVU: Drekatu, *Mead* 2003 j (K), 2004 s (K), 2005 s (K). Nanduri, *Tothill* 553 s (K). Thakaundrove, Mt. Kasi, *A. C. Smith* 1773 ♂ 300–400 m. (A, K, NY, US), *Tuidrokadroka* s.n. ♀ 300–430 m. (A). Without loc., *Stauffer & Kuruvoli* 5841 ♀ (z), 5842 j (z). KADAVU IS.: *Damanu* KU19 ♀ (K), 53 ♀ (K).

The variety *nidulum* differs from the variety *araucarioides* in its more dispersed leaves with blunter and less incurved tips. Not more than the upper third of the leaf is incurved and the leaves are not distinctly wider than thick. Transitional specimens can be found, particularly with the penultimate branches more *araucarioides*. The ripe cone is said to be brown. The brown bark peels in thin flakes and has lenticels.

6b. Var. *araucarioides* de Laubenfels, var. nov.

Folia conferta, valde incurva, imbricata, acuta, latiora quam crassa. Squama strobilorum masculorum triangularia, apice non elongata. Holotypus: *Versteegh* BW 3041 (A), New Guinea, Wissel Lake. FIG. 3b.

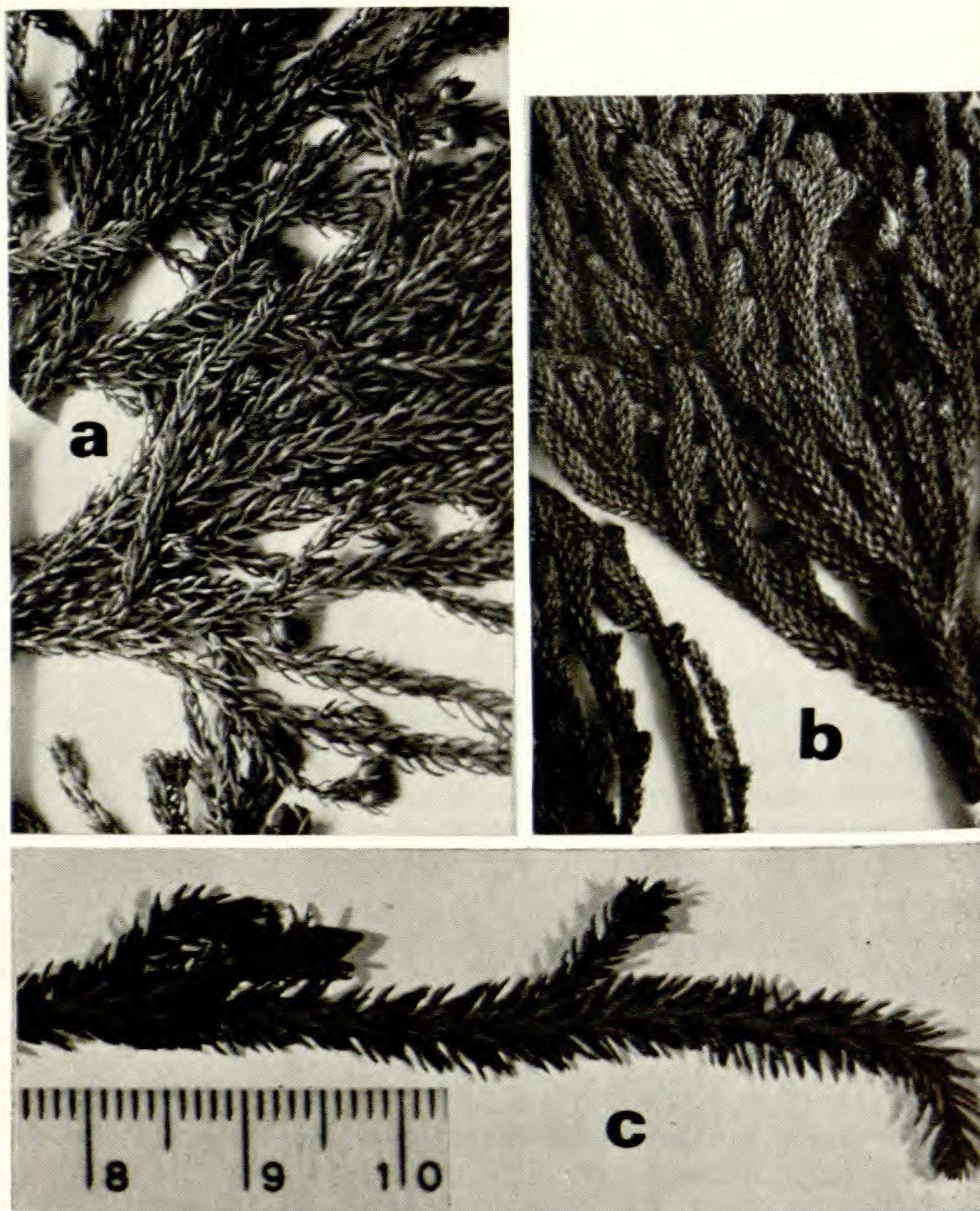


FIGURE 3. a, *Dacrydium nidulum* de Laubenfels var. *nidulum*, portion of the holotype, Vink BW 15271 (L); b, *D. nidulum* var. *araucarioides* de Laubenfels, portion of the isotype, Versteegh BW 3041 (L), a and b natural size; c, *D. spathoides* de Laubenfels, portion of the holotype, Brass 12659 (A), enlarged.

DISTRIBUTION. At intermediate elevations along the main mountain chain of New Guinea, 1,750–2,770 (rarely down to 750) meters, mostly in peat and swamp forest.

New Guinea. WISSEL L.: Versteegh BW 3041 ♀ (A-holotype; K, L-isotypes), Eyma 4790 ♀, ♂ (A, K, L), 5103 ♂ 1,750 m. (A, K, L). Near Kebo, Vink & Schram BW 8620 s 1,755 m. (L), BW 8796 s 1,800 m. (L, LAE), BW 8914 ♀ 1,750 m. (L, LAE). WESTERN MTS.: Mt. Genofa, Salverda bb22571 j 1,000 m. (L), bb22576 s 750 m. (L). CENTRAL MTS.: Endarotali, Rappard BW 697 ♀ 1,750 m. (L). Mt. Hellwig, Pulle 801 ♂ 1,450 m. (L). TERR. NEW GUINEA:

Kandep Valley, *Robbins* 3266 ♂ 7,500 ft. (L, LAE), *Flenley ANU* 2828 ♀, j (L). Upper Kaugel Valley, *Bowers* 188 j (LAE). PAPUA: S. Highlands, 8 miles E. of Mendi, *Pullen* 2674 s 5,700 ft. (L, LAE), 2680 j (LAE).

The crowded and incurved leaves of *Dacrydium nidulum* var. *araucarioides*, which expose only their rounded dorsal surface, are reminiscent of *D. araucarioides* and of the leaves of various *Araucaria* species. The pollen cones available have sporophylls which are less elongated and less imbricate than is true of related taxa. The gray-brown bark is flaky. The ripe cone is red.

7. *Dacrydium balansae* Brongn. & Gris, Bull. Soc. Bot. France 16: 328. 1869. Type: *Balansa* 1380, New Caledonia, Bourail.

A tree 4 to 12 m. high, sometimes taller; bark in thick brown plates, fibrous within but the surface with a tough smooth cuticle and numerous small lenticels, weathering gray; branching into many small spreading shoots; juvenile leaves fine needles up to 13 mm. long, gradually changing to the adult form; mature foliage leaves thick, strongly tapering from a decurrent base 1–2 mm. wide, spreading and slightly incurved at the blunt tip, strongly keeled, particularly on the dorsal side, margins sharp, 3–4.5 mm. long, on branches bearing fertile structures somewhat smaller, often slightly glaucous; pollen cones cylindrical 8–15 mm. long, 2 mm. in diam., terminal, often on short branches, or lateral, or both together; microsporophyll triangular, acute but not elongated; seed cones terminal on long or short branches with somewhat reduced leaves for as much as 2 cm. below the cone; often with a twist below the fertile area; seed cone scales elongated, 3.5–4 mm. long, not more than 1 mm. wide, not tapering, one or rarely two of the uppermost fertile; ovule at first inverted and buried among the cone scales but gradually becoming nearly erect; mature seed spreading the cone scales apart but more or less surrounded and emerging slightly if at all, oval-elongated, wider than thick, tapering to a blunt tip with marked lateral keels, up to 5 mm. long, 3.5 mm. wide.

DISTRIBUTION. Throughout New Caledonia in drier forests, generally over serpentine at low elevation (up to 900 meters), and occasionally in more moist forest.

New Caledonia. Valley of Amona near Wagap, *Vieillard* 3262 ♂ (GH, K, NY, P, z). Mt. Koniambo-Koné, *Däniker* 909 s 400–600 m. (P, z). Mt. Paéoua, *McKee* 17028 s 600–900 m. (P). Mt. Boulinda above Oua Nepoua, *McKee* 17194 s 800 m. (P). Above Houailou, Me Maoya, *McKee* 9891 s 800–900 m. (P). Below Téné near Bourail, *Balansa* 1380 ♀ (P-holotype; BM, K-isotypes). Kuana R. E. of Table Unio, *Buchholz* 1601 j (ILL, P). Bogota Penn., *Brousse* s.n. s (P). Col de Perchicara (Thio-Canala), *Veillon* 145 s 200 m. (P). Col de Nakety (Thio), *Guillaumin, Chevalier & Hürlimann* 1445 s 150 m. (P, z). Dothio Kieho Valley, *McKee* 16510 j 100 m. (P). Ouroné (mouth of Dothio), *Balansa* 3484 ♀ (BM, NY, P). Lower valley of Thio, *McKee* 15433 ♂ 10–100 m. (P), *McMillan* 5158 ♂ (A, K, P). Slopes of Mt. Douetampo (Thio), *Corbasson* 13914 s 800 m. (P). N'Goye R., *Veillon* 511 s 10 m. (P). Mt. Vulcain (upper

Tontouta), *Buchholz* 1574 ♀ (ILL, K, P), *de Laubenfels* P412 ♀ 560–900 m. (A, K, RSA, SBT), P412A j (A, RSA, SBT), P413 ♂ (A, RSA, SBT), *Aymard* 16346 ♀ 600 m. (P), *Viro*t 400 s 300 m. (A, P), *Baumann-Bodenheim* 8053 s (P, z), 8168 s (P, z), 8268 s (P, z), 8808 s (P). Valley of Kalauéhola (Tontouta), *Däniker* 587a s (z), *Hürlimann* 1679 s 150 m. (P, z). Ni, *Hürlimann* 1708 s 850 m. (P, z). Slopes of Mt. Mou, *White* 2001 s (K, P). E. slopes of Erembéré, *Viro*t 37 j 600 m. (A, P). Trail to Mt. Dzumac (N. of Couvelée R.), *Franc* 2492 ♀ (K, NY, P, US, z), 2493 ♂ (K, NY, P, US, z), 2494 s (A, K, z), *Le Rat* 2864 ♀ (P), 2866 s (K), *Viro*t 187 ♂ (A, NY, P, US), *de Laubenfels* P155 ♀ 600 m. (SBT), *Bernier* 302 j (P), 303 ♂ (P), *Hürlimann* 1088 s (P), *McKee* 2521 ♂ (A, P), 2522 j (A). Banks of Couvelée R., *Balansa* 1380A ♂ (NY, P). Banks of Dumbéa R., *Pancher s.n.* s (P), *Vieillard* 1278 s (P). Forest of Mois de Mai (upper Yaté), *Buchholz* 1381 j (ILL, K, P), *Baumann-Bodenheim* 14987 j (P, z), 14993 s (P, z), 14997 j (P, z), *Bernier* 309 ♂ (P). R. Bleue (Walker Forest), *Bernier* 304 j (P), 305 ♂ (P), 306 j (P), 307 j (P), 308 s (P), *de Laubenfels* P393 ♂ 160 m. (A, K, RSA, SBT), *McKee* 12906 ♂ (P), *Aubréville & Heine* 184 ♂ (P), *Hürlimann & Lucien* 3486 s 200 m. (z). Pirogues R., *White* 2238 s (K, P). South, *Raoul s.n.* s (ILL, P). Without loc. *Franc* 1964 s (A, BM, NY, P, US, z).

ILLUSTRATIONS. PILGER, R. *Pflanzenreich* IV. 5 (Heft 18): fig. 5D. 1903; *Nat. Pflanzenfam.* ed. 2. 13: fig. 118D. 1926; SARLIN, P. *Bois et Forêts de la Nouvelle-Calédonie*, t. 20. 1954.

The elongated bracts surrounding the mature seed distinguish this species from all other except *Dacrydium araucarioides* which has larger pollen cones and differently formed foliage leaves. Sterile specimens have more robust leaves than those of other species where a similar leaf shape is found. When growing in wet forests, particularly the collections from R. Bleue, the trees can grow to more than 20 m. and the leaf form is more incurved and acute in the manner of *D. nidulum* var. *araucarioides*. No seed structures have been collected for this variant and its status remains uncertain.

8. *Dacrydium araucarioides* Brongn. & Gris, *Ann. Sci. Nat. Paris* V. 6: 244. 1866. Lectotype: *Vieillard* 1277, New Caledonia, Canala.

Dacrydium arthrotaxoides Carrière, *Traité Conif.* ed. 2. 697. 1867. Type: *Vieillard* 1277.

Podocarpus araucarioides (Brongn. & Gris) Sebert & Pancher, *Not. Bois N. Caléd.* 171. 1874.

Small tree 3–6 m. high; bark in thick rough flakes, dark brown and slightly fibrous within, more or less smooth on the surface at first with occasional lenticels, weathering gray; branches spreading and becoming erect candelabra-like, rather open; juvenile leaves acicular, dense, curved, up to 12 mm. long; transitional leaves shorter and thicker, closely resembling the mature leaves of *D. balansae*, but somewhat longer, 5–7 mm. long; mature foliage leaves developing gradually from the transitional stage, spreading but distinctly incurved with the blunt tip sharply curved and directed towards the branch axis, imbricate, only the angularly keeled upper middle dorsal part of the leaf exposed, aggregating to form a smooth

thick branch 4–6 mm. in diam., strongly keeled on the axial side toward the leaf base, becoming concave toward the leaf tip, 3–5 mm. long, 1–1.4 mm. wide; pollen cones terminal, often on short lateral branches, or lateral just below a terminal cone, cylindrical, 9–18 mm. long, 2.5–3 mm. in diam.; microsporophylls long triangular, acute with an incurved tip; seed cone terminal on short to long branches whose leaves are about 3 mm. long and strongly curved, cone bracts noticeably longer and straighter, at the cone apex about 5 mm. long, the tip slightly hooked, the whole cone becoming red and fleshy when mature; 1–3 seeds surrounded by the bracts, becoming erect and almost as long as the enclosing bracts, oval but tapering to a blunt apex and wider than thick, 4.5 mm. long.

DISTRIBUTION. Common and locally dominant throughout the serpentine scrub of the southern half of New Caledonia at low elevation and up to at least 1,000 meters.

New Caledonia. S. of Poro, *McKee* 14886 s 600 m. (P). Mts. above Canala, *Vieillard* 1277 ♀, ♂ (P-lectotype of *Dacrydium araucarioides* and holotype of *D. arthrotaxoides*; A, BM, GH, K, NY, z-isotypes). Bogota Peninsula, *Sarasin* 294 ♀, ♂ 500 m. (z). Messioncoué near Port Bouquet, *Balansa* 2507 ♀ (K, P), 2508 s (P). Mts. above N'Goye, *Schlechter* 15175 s (K, P, z), 15176 ♀ 1,000 m. (A, BM, K, P, z). Ridge N. of Mt. Tonta, *McKee* 17247 s 950–1,150 m. (P). Mt. Humboldt, *Däniker* 2914 s (z). Mt. Dzumac, *Le Rat* 633 s (K, P), *Franc* 764A s (P), 766 (z), *Alleizette* 119 ♂ (P). Upper Ouinné, *Bernier* 320 s, j (P). Plateau leading to Mt. des Sources, 700–800 m. *Viot* 152 s (A, P), *s.n.* s (A, P), *Bernier* 4 s (P), 5 ♂ (P), 6 ♀ (P), *Buchholz* 1059 ♂ (ILL, P), 1060 ♀ (ILL), 1194 j (ILL, K, P), 1215 ♀ (ILL, P), *de Laubenfels* P373 ♀ (RSA), P374 ♂ (A, SBT), *McKee* 2202 ♀ (A, P, US), 5669 ♂ (P), *Hürlimann* 211 s (P, z). Upper R. Bleue, *Baumann-Bodenheim* 8575 ♀ (P, z), 8576 ♂ (P, z). Mois de Mai (R. Blanche), *McMillan* 5128 ♂ 600 ft. (A, K, P), *Hürlimann* 1561 s (P), *Baumann-Bodenheim* 15002 j (P, z). Mt. Ouenarou, *Baumann-Bodenheim & Guillaumin* 11818 s (P, z). Mt. Dore, *Pancher s.n.* s (P-syntype of *D. araucarioides*), *Baumann-Bodenheim & Guillaumin* 11407 ♀ (P, z), 11430 j (P, z). Mt. Niocol, *Pancher* 380 ♀, ♂ (K, P). Pirogues R., *White* 2122 s (A, K, P). Bois du Sud, *Bernier* 317 ♀, ♂ (P), *Baumann-Bodenheim & Guillaumin* 11028 ♂ (P, z), 12497 j (P, z). Marais Kiki, *McKee* 1124 s 150 m. (A), *Baumann-Bodenheim* 6232 s (P, z), 6256 ♂ (P, z), 6338 ♂, j (P, z), 6363 ♂ (P, z), 13322 s (P, z), Yaté R., *Däniker* 205 pt. ♀, j (z), *Hürlimann* 681 s (P, z), 1561 ♂ (z), *Baumann-Bodenheim* 6071 s (P), *Baumann-Bodenheim & Guillaumin* 6514 s (P, z), 6729 ♀ (P, z), 6752 ♂ (P, z), *Thorne* 28568 ♂ (P), *Baas-Becking & Stratin* 6071 ♂ (z). Upper Vallé du Pin, *Baumann-Bodenheim & Guillaumin* 11941 j (P, z). Creek Pernod, *Hürlimann* 3144 ♂ 170 m. (z), 3145 ♀ (z). Plaine des Lacs (Madelaine R.), *Compton* 320 ♀, ♂ j (BM), *Le Rat* 2631 ♂ (A, P), *Franc s.n.* s (A, K), *Foster s.n.* s (P), *Bernier* 316 j (P), 318 ♀, ♂ (P), 319 j (P), *Buchholz* 1428 ♀ (ILL, K, P), 1466 ♀ (ILL, K, P), *Denizot s.n.* s (P), *de Laubenfels* P114 ♀, ♂ j (SBT), P342 ♂ (A, RSA), *McKee* 16324 j (P), *Guillaumin* 8370 s (P, z), *Aubréville & Heine* 171 ♂ (P), 133 ♀ (P), *Däniker* 205 p.p. s (z); 2781 s, j (z), *Baas-Becking* 6071 ♀ (z), *Blanchon* 737 ♀ (P), *Stauffer & Blanchon* 5812 ♀ (P, z), *Bernardi* 9368 ♂ (P). Upper Pirogues R., *Baumann-Bodenheim & Guillaumin* 11598 s (P, z). Prony, *Balansa* 187 ♀, ♂ (K, P), *Franc* 764 ♀, ♂ (A, BM, K, NY, P, US, z), *Bernier* 801 ♀ (P), *Cribbs* 1581 s (P). Pic Foi, *Brousmiche* 502 s

summit (P). South, *Raoul s.n.* ♂ (P). Without loc., *Deplanche 171* ♀ (P), *Le Rat 1085* s (P), *Veitch s.n.* ♀ (K), *Franc s.n.* (A), *Petit 177* ♂ (P), *Baudouin 620* s (P), *Hürlimann 409* ♂ (P).

ILLUSTRATIONS. BRONGNIART & GRIS, *Nouv. Arch. Mus. Hist. Nat. Paris* 4: t. 2. 1868. PILGER, R. *Pflanzenreich* IV. 5 (Heft 18): fig. 49, F. 1903; *Nat. Pflanzenfam.* ed. 2. 13: fig. 118, F. 1926; SARLIN, P. *Bois et Forêts de la Nouvelle-Calédonie*, t. 17. 1954.

This species is one of the several specialized plants with bizarre form flourishing in the serpentine scrub or maquis in the southern part of New Caledonia under moderate to heavy rainfall. It has enough in common with *Dacrydium balansae* to suggest that it is derived from that species. The robust form parallels that of *D. gibbsiae*, another endemic on serpentine.

9. *Dacrydium lycopodioides* Brongn. & Gris, *Bull. Soc. Bot. France* 16: 329. 1869. Type: *Pancher* in 1869, New Caledonia, Mt. Mou.

Tree to 25 m. or more, profusely branched; bark in brown flakes, fibrous and lighter within, surface more or less smooth and covered by numerous small lenticels; juvenile leaves acicular, very fine, up to 10 mm. long, changing gradually to the adult form; mature foliage leaves flat, lanceolate, slightly keeled on the dorsal surface, with a distinct rib on the axial surface, pungent, spreading and curved so that the tips are parallel with the branch, 3–4.5 mm. long, 0.7–0.8 mm. wide; pollen cones terminal and often also lateral directly at the base of a terminal cone, cylindrical, 4–7 mm. long, 1.2 mm. in diameter; microsporophylls triangular, somewhat elongated, acute, overlapping; seed cone terminal, often on a short branch, leaves just below the fertile structure smaller than ordinary foliage leaves, sometimes only 1 mm. long, bracts of the cone larger towards the apex, up to 2.5 mm. long and partly covering the epimatium, normally only one fertile bract; seed becoming partly erect and completely exposed, rich shining chocolate brown, oval but tapering to a blunt tip, wider than thick, 3–3.5 mm. long.

DISTRIBUTION. In moist forests within a restricted part of southern New Caledonia, from about 900 to 1,400 meters elevation.

New Caledonia. Mount Mou, 1,140 m. *Pancher* (1869) ♀ (P-holotype), *Vieillard (Pancher) 3265*⁴ ♀ (BM, K), *Vieillard 3265* j (GH, K, P), *Pancher* (1870) ♀ (K, P), *Hennecart s.n.* ♂ (P), 547 ♀, ♂ (P), *Balansa 2863* ♀, j (BM, K, NY, P), *Virost 9* j (A, P), 40 j (A, P), *de Laubenfels P134* ♀, ♂ (SBT), *P348* ♀ (A, RSA, SBT), *P350* j (A, RSA, SBT), *P351* j (A, RSA, SBT), *Bernier 291* j (P), *Chevalier s.n.* j (ILL), *Buchholz 1083* j (ILL, P), *Däniker 2827* ♀, j (z), *Hürlimann 1581* j (P), *McKee 2269* j (P), 3514 j (A, P), 3515 j (A, P), *Thorne 28734* j (P), *Baumann-Bodenheim 15611* j (P, z), 15612 s (P, z), *Cale & Naturel 1581* j (z).

⁴ This collection is probably the same as the type. Vieillard's material is mingled with that of Pancher, sometimes with both names, sometimes with the number, and sometimes without.

Ridge above Ouinné R., *de Laubenfels* P448 ♀ 1,000 m. (A, K, RSA, SBT), P449 ♂ (A, RSA, SBT), P450 j (A, K, RSA, SBT), *Bernier* 289 j (P), 290 s (P), *Bernardi* 1248 s 800–1,000 m. (P). Mt. Humboldt, *Baumann-Bodenheim* 15355 j 1,400 m. (P, z), 15405 s (P, z). Without loc., *Mueller* 94 j (P), *Baudouin* 553 j (P).

ILLUSTRATION. SARLIN, P. Bois et Forêts de la Nouvelle-Calédonie, t. 18. 1954.

The small seeds and pollen cones and the short flat acute leaves set *Dacrydium lycopodioides* apart from all other species of the genus but its morphology is not far removed from many of them. It is a rather delicate looking tree with feathery light green foliage which is actually quite tough. Within its limited range it is strictly a canopy tree of mountain forests and does not penetrate the mossy forests along the exposed ridges.

10. *Dacrydium spathoides* de Laubenfels, sp. nov.

Arbor ad 34 m. alta; cortex bracteatus, niger; folia recta, marginalibus parallelis, apice subacuta, plana forma spatharum, dorso carinata, patula, 4–7 mm. longa, 1–1.2 mm. lata. Strobili masculi cylindranei, laterales, aliquot folia minora ad basem, 10 mm. longi, 2.5 mm. crassi; antherae triangulares. Strobili feminei ad apicem ramulorum saepe cum foliis brevibus 2 mm. longis; folia ad basem seminis longiora, 3 mm. longa; semen protrudendum, 4 mm. longum. Holotypus: *Brass* 12659 (A), New Guinea, Barnhard Camp. FIG. 3c.

DISTRIBUTION. In mossy mountain forests from 1,050 to 2,200 meters elevation, on the islands of Borneo and New Guinea.

Sarawak. Mt. Dulit, *Mjoberg* 23 ♂ 1,200–1,500 m. (A, K, NY), *Richards* 1997 s 1,300 m. (A, K, L). Meruong Plateau, *Brunig* S8722 ♀ 3,400 ft. (K, L), S9992 ♀ 1,050 m. (L). **New Guinea.** Idenberg R., 18 miles SW. of Barnhard Camp, *Brass* 12659 ♀ 2,150 m. (A-holotype; BRI, K, L-isotypes), 12660 j (A, BRI, L), *Brass & Versteegh* 11996 2,200 m. (A, BRI, L).

The very flat bracts in the fertile region, longer than the somewhat reduced leaves of the subtending branch, and covering about half of the mature seed, distinguish *Dacrydium spathoides* from all other species except perhaps *D. lycopodioides*, which has distinctly smaller seeds and pollen cones, and much smaller lanceolate rather than linear leaves. These foliage leaves are unusual within Podocarpaceae in their resemblance to juvenile leaves of Cupressaceae, particularly *Juniperus*, differing, however, in their spiral placement. The specimens from Borneo have longer (10–15 mm.) leaves and on *Richards* 1997, which may be slightly juvenile, they spread at right angles to the branch rather than at an angle of about 45°, as in other specimens. The Borneo material may possibly represent a separate taxonomic entity.

11. *Dacrydium magnum* de Laubenfels, sp. nov.

Arbor ad 30 m. alta; ramosissima; rami dense foliati, 6–7 mm. diametro; folia acicularia, acuta, falcata, dorsaliter carinata, 4–6 mm. longa, 0.3–

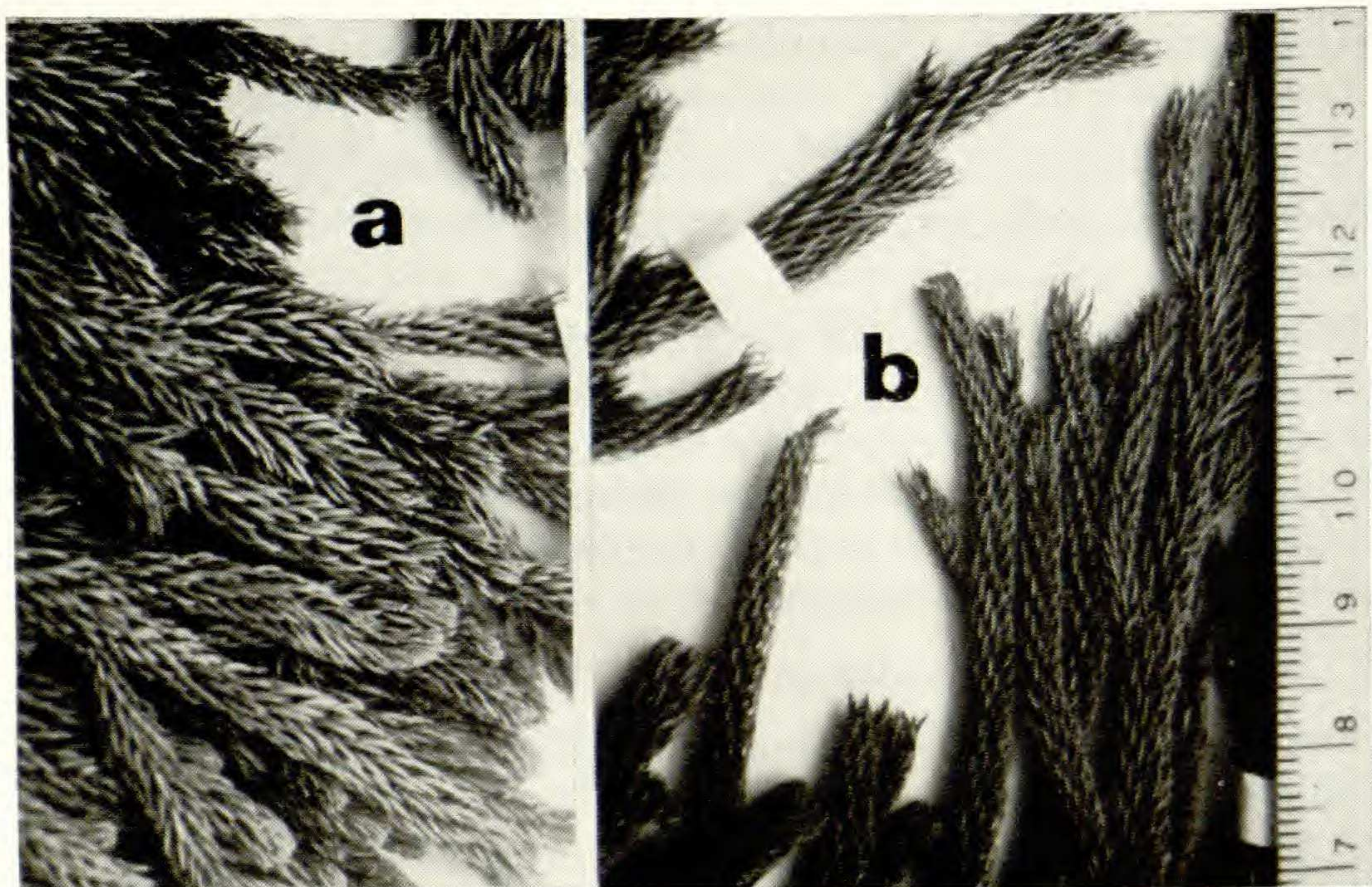


FIGURE 4. a, *Dacrydium magnum* de Laubenfels, portion of the holotype, *de Haan* bb23806 (L), enlarged; b, *D. beccarii* Parlatores var. *rudens* de Laubenfels, portion of the holotype, *Brass* 27821 (A), enlarged; a and b are at same magnification.

0.4 mm. lata. Strobili feminei ad apicem ramulorum, saepe ramulorum brevium folia diminuta, folia strobili semen solitarium cingendum. Semen 5 mm. longum. Holotypus: *de Haan* bb23806 (L), Moluccas, Obi. FIG. 4a.

DISTRIBUTION. The island of Obi in the Moluccas in primary forest and locally common.

Moluccas. Obi, *de Haan* bb23806 ♀ 500–600 m. (L-holotype), bb23807 j (L).

This isolated collection from a poorly studied region is distinct from all other *Dacrydium* species in having the seed surrounded by slender bracts no longer than the foliage leaves, protruding only slightly when mature. It differs from *D. beccarii* and *D. xanthandrum*, whose seeds are well exposed when mature but are produced on branches with distinctly reduced leaves, whereas the fertile branch of *D. magnum* has unreduced leaves. The leaves are also more spreading and rigid than those of *D. beccarii* but not at all flattened as in *D. xanthandrum*. This new species differs from *D. gibbsiae* by the slender bracts in the fertile area, that are less than half as wide and not flattened. Juvenile leaves are at least 17 mm. long. The mature foliage leaves are slightly incurved so that their tips are not exposed.

12. *Dacrydium beccarii* Parlatores in DC. Prodr. 16 (2): 494. 1868.
Lectotype: *Beccari* 2385, Sarawak, Mt. Poe.

Bush 3–4 m. high to tree, rarely up to 35 m.; bark smooth, thin, gray, and fissured, sometimes scaly, brownish within; profusely branched forming an umbrella-shaped crown with the twigs stiffly erect; juvenile leaves very slender, up to 20 mm. long, changing gradually to the adult form; mature foliage leaves needle-like, strongly keeled on the dorsal side, spreading but curved axially, acute, crowded; pollen cones ovoid, at least 10 mm. long and 3 mm. in diam., subtended by a few reduced needle-leaves, lateral as short side branches, or terminal; microsporophyll lanceolate, acute, more than twice as long as wide; seed cones placed in the same manner as the pollen cones and formed of spreading reduced needle-leaves, becoming reddish when ripe; seed solitary or a pair in a nearly terminal position, becoming nearly erect, oval-elongated, wider than thick, 4 mm. long, well exposed when ripe.

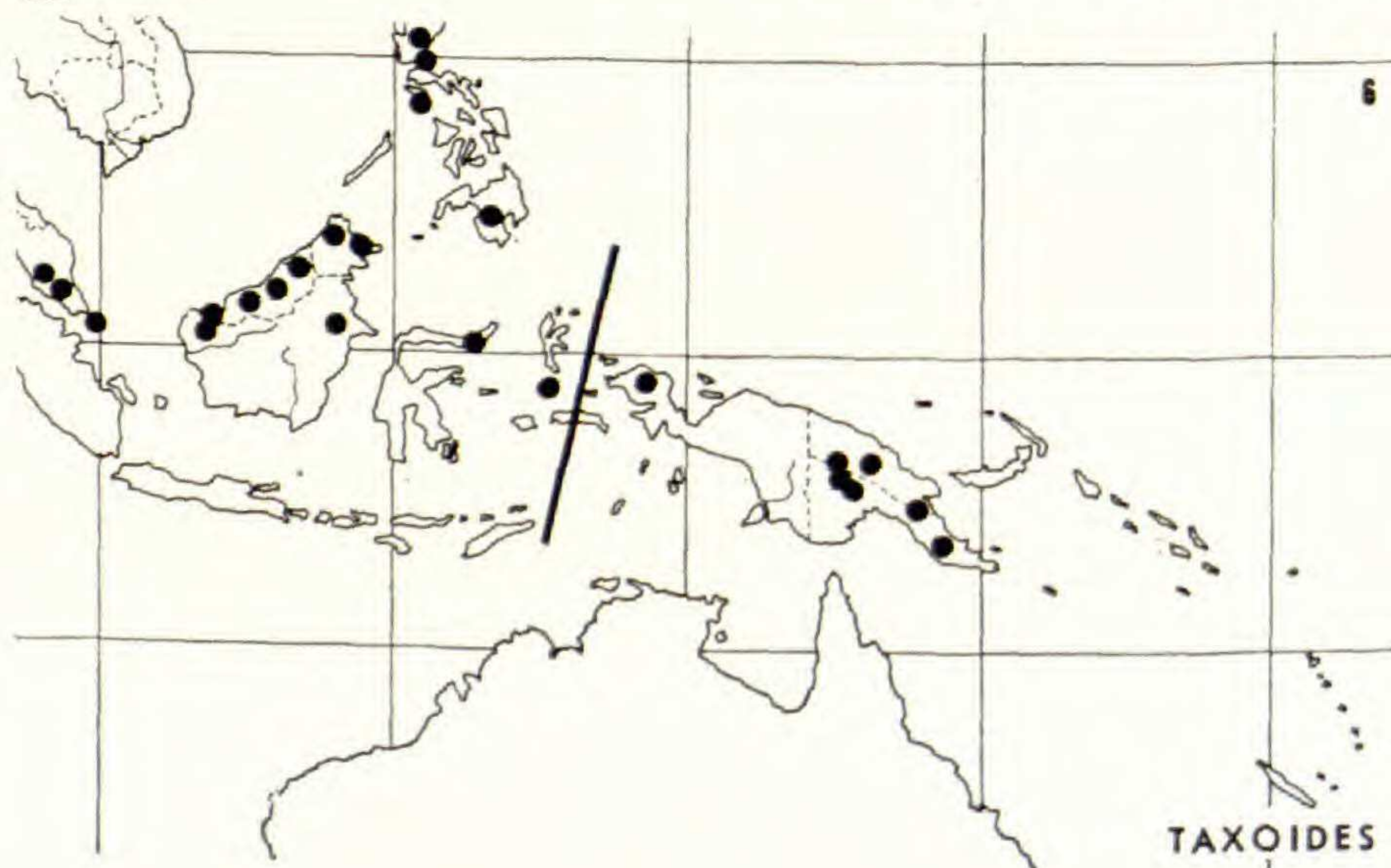
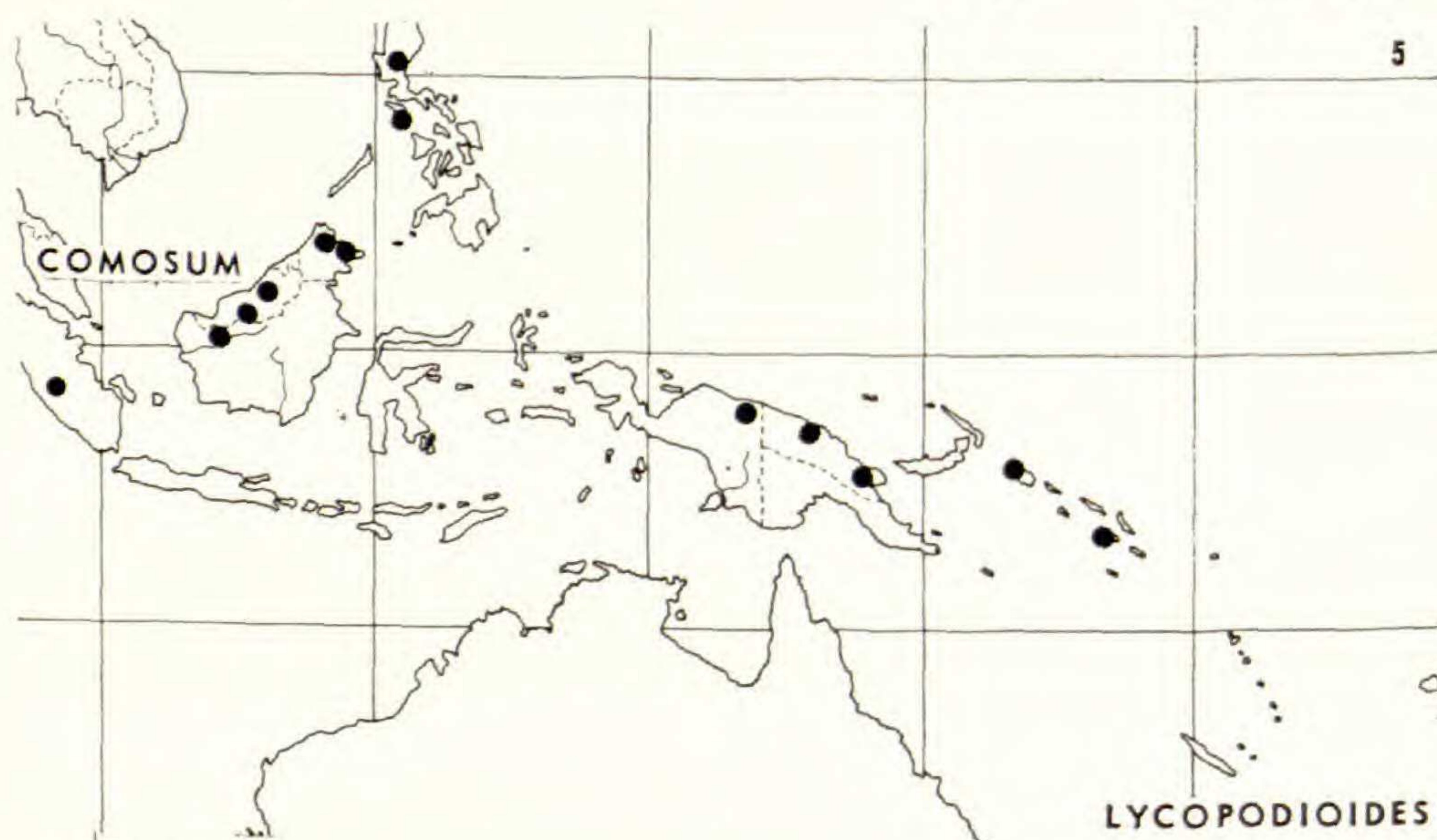
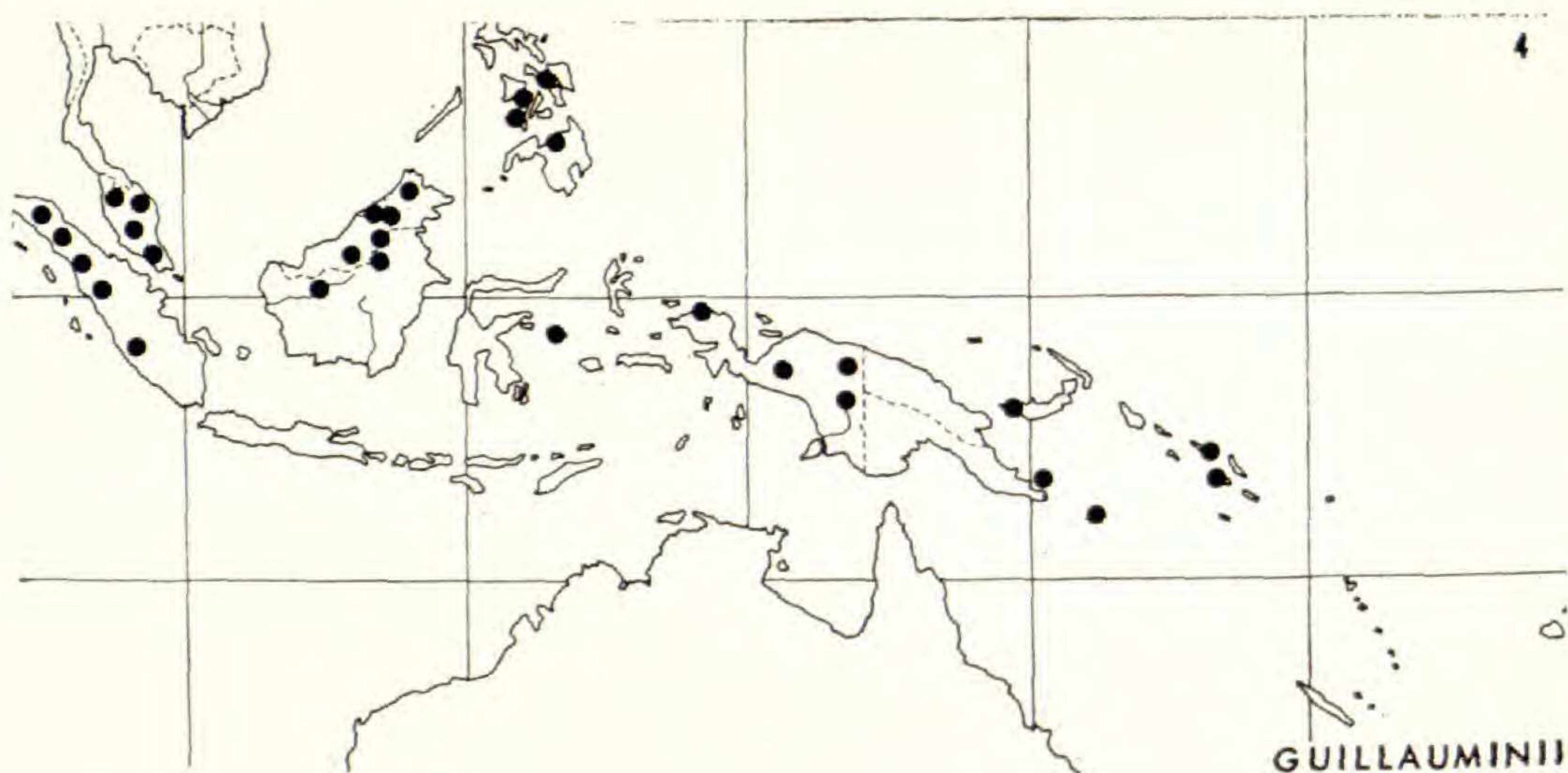
The reduced needles of the fertile shoots and the not elongated cone bracts distinguish this species from all others except *Dacrydium xanthandrum* whose foliage leaves have a different form. Sterile specimens are characterized by their fine slender crowded needles without incurved tips, strongly resembling the juvenile leaves of many other species but generally more crowded and shorter. Three varieties have been recognized based on contrasts in leaf form.

12a. Var. *beccarii*.

Leaves dense, crowded, 5–8 mm. long or longer, 0.4–0.8 mm. wide.

DISTRIBUTION. In scrub formations on exposed ridge tops and in high mossy forests, from Malaya to the Solomons generally in somewhat isolated localities, from 1,000 to over 2,000 meters, or rarely as low as 500 meters. MAP 4.

Malaya. Kedah Peak, *Kochumen* 79133 ♂ 3,800 ft. (κ, L), *Robinson & Kloss* 6053 j (κ). G. Luas (Perak), *Yapp* 493 j 5,200 ft. (κ). Perak, *Scortechini* s.n. ♀ (A, κ). G. Benom (Pahang), *Mus* (1925) ♂ 5,000 ft. (κ). Mt. Ophir (Jahore), *Griffith* 5003 ♀ (GH, κ), s.n. ♂ (L), *Kerr* 3155 ♀ 1,300 m. (κ), *Maingay* 2750 ♀ (κ). Without loc. *Holtum* 20711 s 6,000 ft. (BRI). **Sumatra.** Atjeh, Gajoland, *Van Steenis* 8357 ♂ 2,600 m. (L). Atjeh, Tamyang, *NIFS* bb10748 ♂ 950 m. (L). Karoland (E. Coast), *NIFS* bb7707 j 1,400 m. (L). Siborong (Tapanuli), *NIFS* bb3829 s 1,900 m. (L). Silindung (Tapanuli), *NIFS* bb5671 s 1,300 m. (L). Lubuksikaping, *NIFS* bb6737 j (L). Betw. Djambu Dolok and Baturangin, *Surbeck* 107 ♀ (A, L). **Sarawak.** Mt. Poe (G. Rumpit), *Beccari* 2384 s 5,000 ft. (FI), 2385 ♀ (FI-lectotype; κ-isotype), *Clemens* 20385 s, j 6,000 ft. (A, κ, NY), *Anderson* 190 ♀ 2,000 m. (κ), *Hewitt* (1900) s (κ). Merurong Plateau, *Brunig* S9990 s 2,300 ft. (L). Mt. Dulit, *Richards* 1059 j 1,230 m. (A, κ, L), 1808 ♀ 1,100 m. (A), 1996 s 900–1,000 m. (A, κ, L). Mt. Penrissen, *Mjoberg* 221 j 4,400 ft. (A, NY). **North Borneo.** Mt. Kinabalu, *Smythies* S10607 s 6,000 ft. (κ, L). Ranau, *Mujin* 33774 ♀ 5,300 ft. (κ, L). Kota Belud, *Meijer* SAN 21086 ♂ 5,000 ft. (κ), *SAN* 21100 s (κ, L). Without loc., *Comber* 101 ♀ 5–6,500 ft. (κ). **Borneo.** West, Bengkajang, G. Bawang, *NIFS* bb24779 s 1,442 m. (A, L). G. Damus, *Hallier* 510 s (L). Ulu Kelan, *Molengraaff* B3475 j 1,000 m. (L, NY), 3476 j (L). Amai Ambit, *Hallier* B3431 s (L, NY). Mt. Bongo,



MAPS showing distribution of: 4, *Dacrydium beccarii* Parlatores (dots), *D. guillauminii* Buchholz, known only from New Caledonia; 5, *D. xanthandrum*

Haviland 2070 s (K). **Philippines.** LEYTE: Biliran, *Sulit* 21694 s 1,350 m. (L). NEGROS: Dumaguete, Or, *Herre* 1150 s 4–6,000 ft. (A, NY). Mt. Canlaon, *Edaño* 21936 j 1,860 m. (L). Mt. Marapara, *Curran & Foxworthy* 13612 s (L, NY, US). Mt. Silay, *Everett* 4227 j (NY, US). Without loc., *Britton* 343 s 1,700 m. (L). MINDANAO: Mt. Malingdang, *Mearns & Hutchinson* 4547 s (K, L, NY, US), 4731 s (NY, US). **Moluccas.** Taliabu, *Hulstijn* 126 ♀ (L). **New Guinea.** Vogelkop, Upper Aifat Valley, *Moll BW* 12853 s 870 m. (L); Tamrau Ra., *Van Royen & Schram* 7791 s 920 m. (K, L, LAE). Cycloop Mts., *Gjellerup* 572 s 600–1,500 m. (A, K, L). Hellwig Mts., *Lorents* 1698 s 2,100 m. (K, L). Wissel L., Maiare, *Eyma s.n.* s (L). Normanby I., *Brass* 25660 ♀ mt. crest (A, K, L, LAE, US). **New Britain.** Mt. Tangis, *Frodin NGF* 26902 s 3,500–5,000 ft. (L). **Solomon Is.** Santa Ysabel, *Baea BSIP* 2475 ♀ well above 3,000 ft. (ridge top) (K, L, LAE), *Brass* 3264 ♂, j 1,100 m. (A, BRI, L). Guadalcanal, Mt. Popomansiu, *Braithwaite* 4810 ♀ (K), *Hill* 9004 j 7,000 ft. (K).

ILLUSTRATION. CORNER, E. J. H. Gard. Bull. Straits Settlements 10: t. 6. 1939.

The branches of this variety have a definite bushy aspect because of the fine dense growth of needles. Several specimens with leaves more robust than normal for the species have been included here, although their status is a little uncertain. These include *Van Steenis* 8357, *Brass* 3264, and *Brass* 25660.

12b. Var. *subelatum* Corner, Gard. Bull. Straits Settlements 10: 243. 1939. Type: *Corner SFN* 33224, Malaya, Pine Tree Hill.

Adult leaves noticeably less bushy than in the typical variety, variable in length, 3–6 mm. long; up to three seeds in a fertile structure.

DISTRIBUTION. Mixed with var. *beccarii* in the mossy forests and exposed ridges of Malaya, from 1,200 to 2,300 meters.

Malaya. G. Bubu (Perak), *Wray* 3875 ♀ 5,000 ft. (A, K). G. Tahan (Pahang), *Haniff & Nur SFN* 7994 ♂ 5,500–7,000 ft. (K). G. Tapis (Pahang), *Symington & Kiah s.n.* ♀ 4,600 ft. (K). Fraser Hill (Pahang), *Cubitt* 6519 s (K). Pine Tree Hill (Pahang), *Corner SFN* 33224 s 4,200 ft. (K-isotype). G. Padang (Trengganu), *Moysey SFN* 31072 s 4,000 ft. (K), *SFN* 31841 s 3,800 ft. (K).

ILLUSTRATIONS. CORNER, E. J. H. Gard. Bull. Straits Settlements 10: t. 7 & 8. 1939.

Only the shorter needles distinguish this variety from variety *beccarii*, and intermediates between them can be found.

12c. Var. *rudens* de Laubenfels, var. nov.

Folia patula incurvata conferta in forma *rudenti*. Holotypus: *Brass* 27821 (A), Sudest Island. FIG. 4b.

Pilger (dots), *D. comosum* Corner, known only from the Malay peninsula, *D. lycopodioides* Brongniart & Gris, known only from New Caledonia; 6, *Falcatifolium falciforme* (Parlatore) de Laubenfels (dots west of line), *F. papuanum* de Laubenfels (dots east of line), *F. taxoides* (Brongniart & Gris) de Laubenfels, known only from New Caledonia.

DISTRIBUTION. New Guinea to Sudest I., from 300 to 3,000 meters in elevation.

New Guinea. WESTERN HALF: Mt. Goliath, *de Kock* 42 s 3,000 m. (L). Without loc., *Brandenhorst* 132 s (L), 133 s (L), *van Römer* 1233 s (L). Sudest (Tagula) I., *Brass* 27821 ♀ 500–600 m. (A-holotype; K, L, US-isotypes), 28187 ♀ 300 m. (A, K, L, US), 28188 j (A, L, US).

This variety with incurved leaves forming a compact and smooth rope-like branch system contrasts strongly with the two varieties which have spreading leaves and a ragged appearance. Otherwise var. *rudens* does not differ significantly from the remaining varieties of this species.

13. ***Dacrydium xanthandrum*** Pilger, Bot. Jahrb. 69: 252. 1938. Lectotype: *Clemens* 4504, New Guinea, Morobe District.

Tree to 30 m. high, sometimes stunted on ridges; densely branched; bark chocolate brown or reddish, peeling in thick flakes, bearing lenticels; leaves spreading obliquely, slightly incurved, linear-lanceolate, generally wider than thick, keeled on the back, acute, 6–10 mm. long, or longer on vigorous branches and when juvenile, 0.6–0.8 mm. wide, not crowded; pollen cones lateral or terminal and subtended by several reduced leaves, oval to cylindrical, 5–13 mm. long; microsporophylls narrowly triangular to lanceolate, acute, 2–2.5 mm. long; seed cones terminal, often on very short branches, fertile bracts in the form of reduced leaves; seeds rich tan, 2-angled, 5 mm. long, more or less protruding when mature. FIG. 5.

DISTRIBUTION. The island of Borneo and the Philippines to the Solomons, in the mountains from 1,000 to 2,400 meters, rarely down to 500 meters above sea level. MAP 5.

Sumatra. Road from coast to Tapanuli (Toba L.), *Bangham* 1070 ♀ 4,100–4,500 ft. (A, K, NY). **Sarawak.** Mt. Luiga, *Beccari* 3948 ♂ (FI). Baram, *Anderson* 4545 ♀ 4,800–7,000 ft. (K, L). G. Mulu, *Hotta* 14597 ♂ 1,200–1,600 m. (L). **North Borneo.** Kinabalu, *Nicholson* SAN 17827 ♀ 8,800 ft. (BRI, K, L), *Clemens* 32502 s 6,000 ft. (A, K, L, NY), 34341 ♀ 5–6,000 ft. (A, K, L, NY). Ranau, *Nicholson* SAN 39768 ♀ 8,000 ft. (K), *Meijer* SAN 29153 s 7,000 ft. (K, L). Tambunan, *Mikil* SAN 32086 ♂ montane (K, L). Penampang, *Clemente* 5980 s 5,000 ft. (K, L), *Leaño-Castro* 5985 s (K, L). Mt. Alab, *Keith* 5965 j 6,000 ft. (K, L). **W. Borneo.** B. Raja, *Winkler* 1037 ♂ 1,600 m. (L). **Philippines.** Mt. Umingan (Nueva Ecija), Luzon, *Ramos & Edaño* 26510 ♀ (A, K, US). Mt. Halcon, Mindoro, *Rabor* 20485 ♂, j 1,600 m. (L), *Edaño* 3265 s 780 m. (A), *Merrill* 5714 s (US), 5789 j (NY, US). Calapan, Mindoro, *Vidal* 3910 ♀ (A, K). **New Guinea.** Cycloop Mts., *Karstel* BW 5440 s 510 m. (L, LAE). Sepik region, *Ledermann* 9395 s (L). Chimbu, *Cavenaugh* NGF 3334 j (A). Morobe District, Ogeramnang, *Clemens* 4504 ♂ (A-lectotype; z-isotype), 5390 ♀ 5,900 ft. (A-syntype), 6398 ♀ 5,850 ft. (A-syntype), 6408 s 5,850 ft. (A), 6488 s 4,500 ft. (A). **Bougainville Is.** *Kajewski* 1694 ♂ 950 m. (A, BRI), 1709 ♀ 1,000 m. (A, BRI, L). **Solomon Is.** Guadalcanal, *Walker* BSIP 247 ♀ 1,500 ft. (A, BRI, K, L), *Kajewski* 2652 s 1,200 m. (A, BRI, L).

The range of this species overlaps that of *Dacrydium beccarii* with which it is often confused, both being found for example, at Ranau and

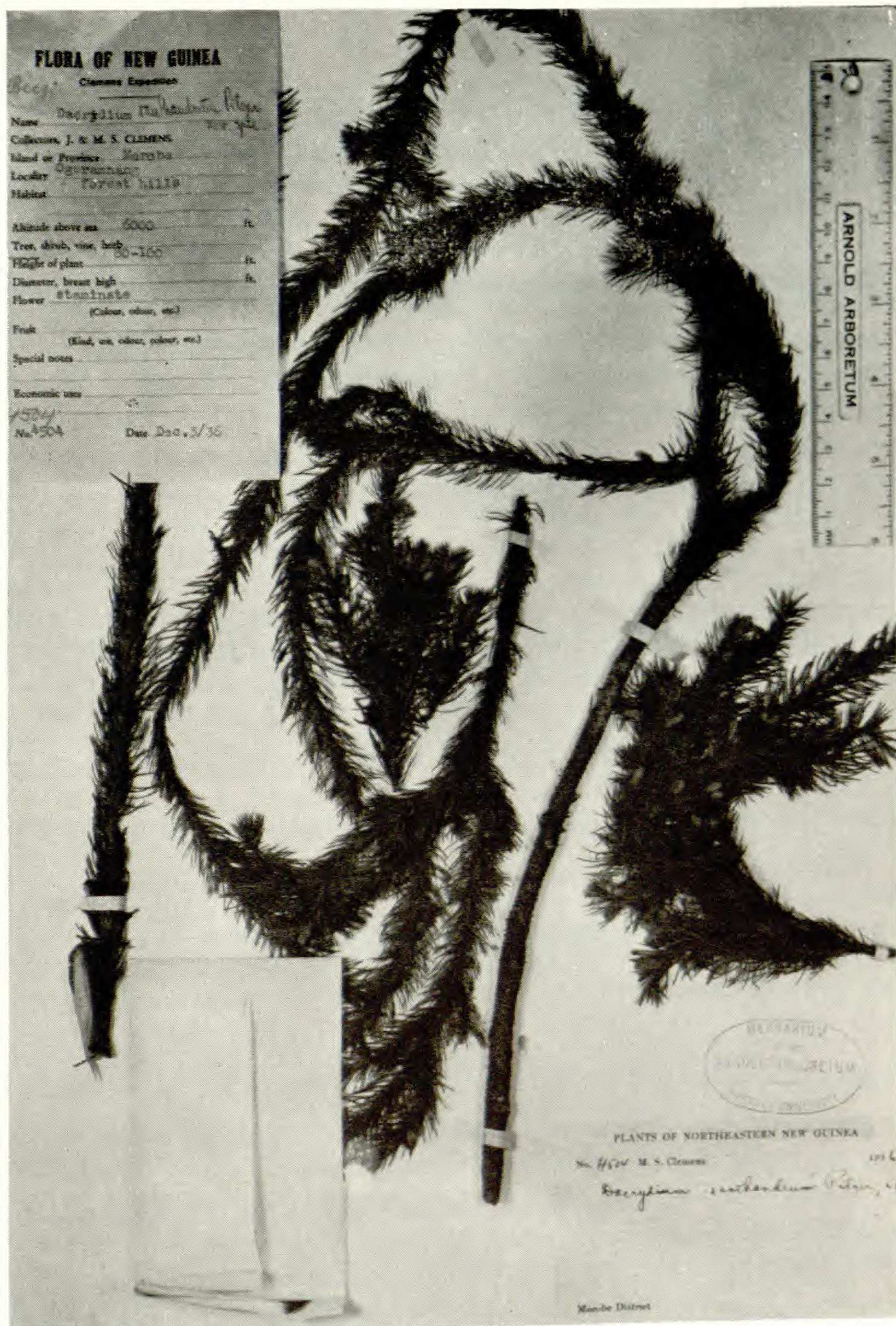


FIGURE 5. *Dacrydium xanthandrum* Pilger, photograph of the lectotype, Clemens 4504 (A).

on Mt. Kinabalu. *D. xanthandrum* differs in the noticeably flattened leaves which are widely spreading and distinctly less dense. It also grows with *D. gibbsiae* and its leaves strongly resemble the transitional leaves

of that species, but, not only are the adult leaves of *D. gibbsiae* much more robust, the pollen cone is much larger, and the fertile shoots have unreduced leaves. The specimen from Sumatra cited here has much more robust leaves similar to nearly mature leaves of *D. gibbsiae* and may, with more material, be found to represent a distinct taxonomic unit.

14. *Dacrydium gibbsiae* Stapf, Jour. Linn. Soc. Bot. 42: 192. t. 4. 1914. Type: *Gibbs 4162*, North Borneo, Mt. Kinabalu.

Dacrydium beccarii var. *kinabaluense* Corner, Gard. Bull. Straits Settlements 10: 244. 1939. Type: *Carr SFN 26437*, North Borneo, Mt. Kinabalu (not seen; photo included in description).

Much branched tree to at least 12 m. high; juvenile leaves acicular, 12–20 mm. long, spreading but slightly incurved; mature foliage leaves becoming wider and thicker but distinctly flattened, incurved and imbricate (an angular keel on the dorsal side), acute, aggregated into rope-like shoots about 8 mm. in diameter, individual leaves 5–7 mm. long, 1.0–1.3 mm. wide, rigid; pollen cones terminal or lateral, cylindrical, 20–25 mm. long by 5–7 mm. in diameter; microsporophyll lanceolate, 5 mm. long; seed cone terminal, often on a very short lateral branch, formed of largely unmodified leaf-like structures and with one or two fertile apical leaves, becoming reddish when mature; seeds becoming almost erect, surrounded by but spreading apart the subtending leaves, oval and tapering slightly towards the apex, 4.5 mm. long.

DISTRIBUTION. On the slopes of Mt. Kinabalu, in serpentine soils where it is common from 1,500 to 3,300 meters.

North Borneo. Mt. Kinabalu, *Gibbs 4162* ♀ over 6,000 ft. (BM-holotype; K-isotype), 4050 j (BM), *Clemens 10685* ♀ (A, GH, K), 10879 j (A), 11091 ♂ (A), 28542 s 11,000 ft. (K), 30922 j 4–5,000 ft. (A, L, NY), 33037 ♀, j 5,000 ft. (A, L, NY), 40151 ♀ 6,500 ft. (A, NY), *Griswold 67* j (A), *Haviland 1183* s 6,600 ft. (K), *Chew & Corner 4303* j (K), 4361 j 7,000 ft. (K), 8024 ♀ (K), *Nicholson SAN 17826* ♀ 9,000 ft. (BRI, L), *Meijer SAN 21097* s 5,500 ft. (K), *SAN 21098* j, 5,000 ft. (K), *SAN 23500* s 6,000 ft. (K), *Colenette 543* s 8,000 ft. (K). Pinosok Plateau, *Colenette 542* ♀ 5,100 ft. (K).

ILLUSTRATION. CORNER, E. J. H. Gard. Bull. Straits Settlements 10: t. 9. 1939, as *Dacrydium beccarii* var. *kinabaluense*.

This is one of the many distinctive endemics of Mt. Kinabalu and, like many, is characteristically robust in form. The pollen cone is unique. With the discovery of fertile *Dacrydium xanthandrum* specimens well up on Mt. Kinabalu, many of the "juvenile" specimens may actually be that species.

15. *Dacrydium guillauminii* Buchholz, Bull. Mus. Hist. Nat. Paris II. 21: 282. 1949. Type: *Buchholz 1728*,⁵ New Caledonia, Rivière des Lacs.

⁵In the description of this species the collection number given is 1278, clearly a typographical error.

Erect bush 1–2 m. high; bark with small dark rough flakes, fibrous brown within, surface more or less smooth at first and covered with numerous small lenticels, developing many small cracks with age; profusely branched; leaves becoming denser and less spreading with age but not at all reduced in size, acute, needle-like or slightly compressed, bushy imbricate, 13–17 mm. long, 1.0 mm. wide; pollen cones terminal and lateral, the lateral ones at the base of a terminal cone and smaller, 8–14 mm. long, tapering from the base; microsporophylls with a long lanceolate tip from 5 mm. at the base of the pollen cone to not more than 2 mm. long near the apex; seed cones terminal, sometimes on very short lateral branches; bracts of the seed cone unmodified or slightly reduced leaves; seeds up to five in a cone, subterminal, oval, wider than thick, laterally keeled, the tip rounded with the micropyle projecting, 4.5 mm. long.

DISTRIBUTION. Probably the most restricted species of the genus, found only for a few kilometers along the Madelaine River (Rivière des Lacs) and on the margins of Lac en Huit, from which that river flows, and only at the very edge of the water.

New Caledonia. Rivière des Lacs, *Buchholz* 1728 ♂ (ILL-holotype; K, P-isotypes), *de Laubenfels* P341 ♀ (A, RSA), P341A ♂ (A, RSA), *Bernier* 323 j (P), s.n. ♂ (P), *Sarlin* 242 s (P), *Däniker* 205 p.p. (z), *Baumann-Bodenheim & Guillaumin* 11798 s (P, z), *Hürlimann* 3471 s 146 m. (z), *Bernardi* 9360 s (P, z), *Blanchon* 1162 s (P). Lac en Huit, *de Laubenfels* P116A ♂ (SBT), P116B ♀ (K, SBT), *McKee* 3385 ♂ (A, K, P, US).

ILLUSTRATION. SARLIN, P. Bois et Forêts de la Nouvelle-Calédonie, t. 21. 1954.

This distinctive bush, a component of the serpentine maquis, bears strong resemblances to *Dacrydium beccarii* and probably represents an endemic pedomorphic variant of that species.

16. *Dacrydium comosum* Corner, Gard. Bull. Straits Settlements 10: 244. 1939. Type: *Corner* 33222, Malaya, Pine Tree Hill.

Tree 4–12 m. high; profusely branched with an umbrella-shaped crown; bark in small flakes; foliage branches bushy, densely leafy; leaves spreading at an angle and then incurved near the base, lanceolate-pungent, distinctly flattened, 12–20 m. long and 0.7–1.3 mm. wide; juvenile leaves up to 33 mm. long; pollen cones unknown; seed cone on a short lateral branch, often with two seeds; seeds 4–5 mm. long.

DISTRIBUTION. Mossy forest on exposed ridges, from 1,200 to 2,000 meters elevation in parts of Malaya, common locally but of restricted range.

Malaya. Pahang. Pine Tree Hill, *Corner* SFN 33222 s 1,500 m. (K-isotype), *Burkill & Holttum* 8536 s (A, K), *Melville & Landon* 4814 s (K). G. Tahan, *Haniff & Nur* SFN 8307 s 1,500–2,000 m. (A, K).

ILLUSTRATION. CORNER, E. J. H. Gard. Bull. Straits Settlements 10: t. 10. 1939.

Like *Dacrydium guillauminii*, *D. comosum* is apparently a pedomorphic variant of some other species, perhaps *D. xanthandrum*. The distinctly flattened and much longer leaves set it apart from *D. beccarii* which grows in the same area. The relationships between the flattened but falcate-leaved *Dacrydium* species (*xanthandrum*, *comosum*, *gibbsiae*, *spathoides*, and *lycopodioides*) are unclear. They may be a group with a common origin or each may have developed separately from other stock. It is worth noting that, where known, their juvenile leaves at intermediate stages have an unflattened form. Thus the flattening, for some at least, does not represent a continuation of the seedling flattened-leaf condition. This is in distinct contrast to the flat and not falcately incurved leaves in other genera of the family.

Falcatifolium de Laubenfels, gen. nov. Type species: *Falcatifolium falciforme* (Parlatore) de Laubenfels.

Frutex vel arbor; folia patentia, falcata, bilateraliter complanata. Ad basem ramorum foliosorum et ramulorum fertilium squamae numerosae, tenues carinatae. Strobili masculi axillares vel terminales in ramulis brevissimis. Strobili feminei in ramulis brevissimis, axillares; squamula ultima sola ovulifera; ovulum unicum inversum, epimatio involutum; semen tandem suberectum, epimatio cristato basi breviter involucrato, crista lateraliter prominens; strobili maturi carnosi.

This new genus was previously included as a part of *Dacrydium*, identified as group A by Florin (1931, pp. 256–259) because of its differences from other members of that genus. Tegnér (1965) also discussed the distinctions between Florin's group A and the rest of *Dacrydium*. Several basic differences justify the separation of *Falcatifolium* as a new genus. The fertile structures in *Falcatifolium* are produced on specialized axillary shoots whereas in *Dacrydium* they grow terminally on ordinary foliage branches. The epimatum of the new genus has a pronounced hump which projects laterally from the mature cone, in contrast with the smaller epimatum of *Dacrydium* which becomes a cup-like fringe at the base of the mature seed, not projecting at all. Very striking in *Falcatifolium* are the bilaterally flattened leaves which spread out distichously, contrasting not only with the fertile shoots and basal scales of new growth, but also with the bifacially flattened juvenile leaves which give way rapidly to the adult form at about the second year of growth. In *Dacrydium* bilaterally flattened leaves do not occur. The name *Falcatifolium* reflects the basal falcate curvature of the leaves away from the branch. Tegnér (1965) further reports a lack of vascular fibers and pollen differences which separate this new genus from *Dacrydium*. Four species can be differentiated, primarily on the basis of leaf form, distributed from Malaya to New Caledonia in moist mountain forests, where they occur as undershrubs or small understory trees.

KEY TO THE SPECIES OF *FALCATIFOLIUM*

1. Leaves broad and flat.
 2. Leaves blunt to acute, normally more than 20 mm. long and 3 mm. wide.
 3. Pollen cone 20–30 mm. long by 2–3 mm. in diam.; upper edge of the leaf normally curved upwards, leaf variable in size and generally more than 25 mm. long. 17. *F. falciforme*.
 3. Pollen cone 15–25 mm. long by 1.5–2.0 mm. in diam.; upper edge of leaf rarely even slightly curved upwards, leaf rarely as much as 25 mm. long. 18. *F. taxoides*.
 2. Leaves apiculate, 12–17 mm. long by 2–3.5 mm. wide. . . 19. *F. papuanum*.
1. Leaves narrow, keeled. 20. *F. angustum*.

17. *Falcatifolium falciforme* (Parlatore) de Laubenfels, comb. nov.

Podocarpus falciformis Parlatore in DC. Prodr. 16(2): 685. 1868. Lectotype: Beccari 2437, Sarawak, Mt. Poe.

Nageia falciformis (Parl.) Kuntze, Rev. Gen. Pl. 800. 1891.

Dacrydium falciforme (Parl.) Pilger, Pflanzenreich IV. 5 (Heft 18): 45. 1903.

Tree 3–10 (rarely to 25) m. tall; bark more or less smooth, rich purple-brown, inner bark dark reddish; leaves variable in size, on mature fruiting trees from 20 to 65 mm. long and 5–7 mm. wide, smoothly curved outward from near the base to the widest part (about one third of the length from the base), then tapering and curving more or less gradually towards the acute tip, smaller leaves which may be almost straight and probably not fully developed, sporadically occurring along with normal leaves, narrowed at the base to a short, angled petiole and then decurrent; pollen cone axial or terminal on a short, 2–3 mm., scaly stalk, cylindrical, 20–30 mm. long and 2–3 mm. in diam.; microsporophyll small, triangular-acute; seed cone on a short scaly shoot up to 5 mm. long, the cone made up of about a dozen larger, acuminate scales, the apical one fertile, the whole cone becoming fleshy on maturity; seed with a humped epimatium at the base, oval, flattened and narrowed to a blunt apical ridge, 6 mm. long, 5 mm. wide, and 4 mm. thick.

DISTRIBUTION. Mostly an understory tree in open rainforests from 600 to 1,650 meters in elevation, from Malaya and Luzon to Obi in the Moluccas. MAP 6.

Malaya. Mengkuang, Wyatt-Smith 93115 ♂ 5,000 ft. (K, L, US). Batu Gajah, Perak, Ridley 5695 ♂ (K). G. Tahan, Haniff & Nur SFN 7851 ♂ (K), Ridley 16026 ♂ (K), 16178 s (K). Pine Tree Hill, Penang, Poore 6228 s 4,300 ft. (K). Fraser Hill, Nur 10507 s 4,000 ft. (A). Lingga Archipelago. Teysmann 169 ♀ (L), Hullett 5695 ♂ (A, BM). Sarawak. Santubong top, Beccari 2126 ♂ (F), Haviland (1890) ♂ 2,800 ft. (K). Mt. Dulit, Richards 1834 ♂ 900 m. (A, BM, K, L), 1836 j (BM, K). Mt. Poe, Beccari 2437 ♀ (FI-lectotype; A, K-isotypes), Clemens 20238 s 6,000 ft. (NY), 20263 s 5,000 ft. (A, NY). Mt. Mattang, Beccari 1331 s (FI), 1697 s (FI), 2941 ♀ (FI), Koley 11669 s (K). Trusan, Brunig S8743 s (K, L). Meruong Plateau, Brunig S9994 s 800 m. (L). Without loc. Anderson 8365 ♂ 2,000 ft. (K, L), Gibbs 4400 s 3,000 ft. (BM, K). Brunei. Ash-

ton BRUN 1031 s 4,300 ft. (K, L), 1066 s 4,750 ft. (K, L). North Borneo. Kina-balun, Clemens 10962 s (A, K), 27851 j 7,000 ft. (BM, K, NY), 33078 ♂ 5,000 ft. (A, K, L, NY), s.n. s 4–5,000 ft. (A, L, NY), Gibbs 4067 s (K), Chew & Corner 1863 ♂ 5,500 ft. (K), 4847 s 5,000 ft. (K). Lahad Datu Dist. (Mt. Silam), Wood SAN A4179 s 2,500 ft. (A, BRI, L), Meijer & Anak SAN 37497 ♂ 2,000 ft. (K, L), SAN 22705 s (K). Penampang, Clemente 5995 s (K), Leaño-Castro 5986 s (K). Ranau, Meijer SAN 20953 s (K), Anon. SAN 20279 j 4,000–4,500 ft. (L). Borneo. Bengkajang, NIFS bb9664 s 1,400 m. (L), bb24778 s 1,200 m. (A, L), bb25157 s 1,100 m. (L). G. Damus, Hallier 506 s (L). Mt. Palimasan, Kostermans 12779 s 500 m. (L). Lianggagang, Hallier 2688 s (L). Philippines. MINDANAO: Davao, De La Cruz 27746 j (US). MINDORO: Mt. Halcon, Merritt 4425 ♀ (F, US), Merrill 5744 s (K, L, NY, US), Rabor 20482 s 1,600 m. (L). Without loc. Whitehead (1896) s, j (BM). LUZON: Mt. Umingan, Nueva Ecija, Ramos & Edaño 26394 ♂ (A, NY, US). Mt. Camatis, Tayabas, Edaño 4508 ♀ (A). Celebes. Manado, Eyma 3671 j (L), NIFS bb17544 s 1,400 m. (A, L), bb21294 ♀ 1,200 m. (L), bb24778 s (A). Obi. de Haan bb23815 j 700 m. (L).

ILLUSTRATIONS. PILGER, R. Pflanzenreich IV. 5 (Heft 18): fig. 4 D-G. 1903; Nat. Pflanzenfam. ed. 13: fig. 227 D-G. 1926; GIBBS, L. S. Jour. Linn. Soc. Bot. 42: t. 8. 1914, all as *Dacrydium falciforme*.

Shape of pollen cone and mature leaf size and shape distinguish *Falcatifolium falciforme* from other species in the genus. In contrast, *F. taxoides* has a more slender pollen cone and mature foliage leaves with only sporadically the slightest upward curve of the upper leaf margin, while in *F. falciforme* such a curve is normally pronounced and only sporadically absent. The mature leaf size of *F. papuanum* is completely below the great size range of *F. falciforme*, differing also in a straight profile and apiculate tip. The larger, probably deep-shade-grown leaves of *F. falciforme* with the sweeping curve of their upper part are attractive and quite unique, paralleled only in *F. angustum* whose leaves are quite narrow.

18. *Falcatifolium taxoides* (Brongn. & Gris) de Laubenfels, comb. nov.

Dacrydium taxoides Brongn. & Gris, Ann. Sci. Nat. Paris V. 6: 245. 1866.

Lectotype: Vieillard 1259 p.p. New Caledonia, Balade.

Podocarpus taxodioides Carrière, Traité Conif. 2: 657. 1867. Type: Vieillard 1259 p.p. New Caledonia, Wagap.

Podocarpus taxodioides var. *gracilis* Carrière, *ibid.* 658. Type: Vieillard 1259 p.p. New Caledonia, Balade.

Nageia taxoides (Brongn. & Gris) Kuntze, Rev. Gen. Pl. 800. 1891; as *N. taxodes*.

Bush or small tree from 2 to perhaps 15 m. high, bark thin, more or less smooth, scattered with lenticels, light reddish brown and fibrous within, occasionally breaking off a flake; loosely branched; juvenile leaves bifacially flattened, long ovate, almost linear, tapering to a sharp tip, keeled on the lower surface, 15–20 mm. long and 1.5 mm. wide; mature foliage leaves somewhat variable, smoothly curved outward at the base and expanding to the greatest width at about one third their length, then tapering slightly toward the rounded or acute apex, sometimes al-

most linear, the tip usually straight and pointing directly outward or occasionally bent slightly towards the branch apex without a corresponding bend in the upper leaf edge (or rarely a slight curve), more or less narrowed at the base to a petiole and then decurrent; pollen cone axillary or terminal, often with several on a short axillary branch with minute scales, cylindrical, 15–25 mm. long and 1.5–2.0 mm. in diam.; microsporophyll with a minute acuminate tip; seed cone on a slender scaly branch up to 6 mm. long, the cone with about a dozen larger elongated scales up to 2 mm. long, the apical one fertile, the whole cone becoming fleshy on maturity; seed with a humped epimatium at the base, oval, strongly keeled on the sides with an elongated blunt tip, 7 mm. long, 4 mm. wide, and 3 mm. thick.

DISTRIBUTION. In moist rainforests (but not mossy forests) as an understory shrub or small tree throughout New Caledonia wherever these conditions occur, which is most commonly in the 800 to 1,200 meter range but occasionally reaching almost to sea level and to at least 1,400 meters.

New Caledonia. Balade, *Vieillard* 1259 p.p. s (p-lectotype of *Dacrydium taxoides* and holotype of *Podocarpus taxodioides* var. *gracilis*). Ignambi, *Compton* 1571 ♀ 3,500 ft. (BM). Upper Diahot, *Hürlimann* 1887 ♂ (P, Z). Mt. Colnett, *Hürlimann* 1965 ♂ (P, Z). Tao, *Baumann-Bodenheim* 15881 s (P, Z). Wagap, *Vieillard* 1259 p.p. s (p-holotype of *Podocarpus taxodioides*; A, BM, GH, ILL, K, NY, z-isotypes). Mt. Paéoua, *McKee* 17038 ♀ 900–1,100 m. (P), 17061 s (P). Mt. Boulinda, *McKee* 17359 ♂ 1,150–1,300 m. (P). Haute Boulari, *Viot s.n.* s (A, P). Mt. Do, *McKee* 15968 ♀ 900–1,000 m. (P). Mt. Humboldt, *Baumann-Bodenheim* 15372 s 1,400 m. (P, Z). Mt. Mou, *Viot* 39 s (P), 469 s (A, P), *Franc* 610 ♂ (A, P), 2090 s (A, NY), 2091 s (A, NY), *Pitard* 2090 s (A), *Buchholz* 1084 ♂ (ILL, K, P), 1447 ♂ (ILL), 1585 s (ILL, K, P), 1586 ♂ (ILL, K, P), 1786 s (ILL, K, P), 1787 s (ILL, K), *de Laubenfels* P131 ♂ (SBT), P352 ♀ 1,140 m. (A, RSA), P353 ♂ (A, RSA), P354 ♂ (A, RSA, SBT), *McKee* 3541 ♂ (A, P), *Thorne* 28705 s (P), *Baumann-Bodenheim* 5654A s (P, Z), 15680 ♂ (P, Z), *Baumann-Bodenheim & Guillaumin* 11259 s (P, Z), 11262 s (P, Z), 11286 s (P, Z), 11287 s (P, Z), 11292 s (P, Z), 11296 s (P, Z), *Blanchon* 340 s (P). Mt. Dzumac, *Barrets* 7 s (P), *Blanchon* 1247 s 700–900 m. (P). Dumbea, Sunshine Mine, *Hürlimann* 1587 s 650 m. (P, Z), 1609 s (P, Z). Mt. Koghis (Mone, Bebo), *Pancher* 379 ♂ (BM, K, NY, P), *Thoret s.n.* ♂ (K), *Balansa* 185 ♂ (K, P), *Stauffer* 5729 s (P, Z), *Baumann-Bodenheim* 14848 s 750 m. (Z), 14856 s (Z), 14912 s 900 m. (Z). Mt. des Sources, *Denizot s.n.* ♂ (P), *Bernier* 293 ♀ (P), 295 s (P), 296 ♂ (P), 297 s, j (P), *Buchholz* 1198 s (ILL, K), 1203 s 800 m. (K, P), 1204 ♂ 800 m. (ILL, K, P), 1205 j 950 m. (ILL, K, P), 1218 ♀, j 750 m. (ILL, K, P), *Hürlimann* 265 s 900 m. (P, Z), 920 s (P, Z), *de Laubenfels* P366 ♀ (RSA, SBT), *Thorne* 28644 s (P), *Blanchon* 566 s 300 m. (P). Upper R. Bleue, *Bernier* 301 s (P), *Baumann-Bodenheim* 15021 ♀ (P, Z), *de Laubenfels* P400 ♂ 800 m. (RSA, SBT), *Aubréville & Heine* 187 s, j (P), *Bernardi* 9404 s (P, Z). Upper Mois de Mai, *Buchholz* 1390 s (ILL, P). NE. of Lac Naoué, *Hürlimann* 3180 s 500 m. (Z). Bois du Sud, *Baumann-Bodenheim* 12492 s (P, Z), 14996 ♀ (P, Z). Upper Kuébini, *Hürlimann* 3542 ♀ 265 m. (Z), 3543 s (Z). Without loc., *Balansa* 184 ♂ (P), *Deplanche* 169 s (P), *Mueller s.n.* s (P), *Sarlin* 229 s (P), *Baudouin* 387 s (P).

ILLUSTRATIONS. BRONGNIART & GRIS, *Nouv. Arch. Mus. Hist. Nat. Paris* 4: t. 3. 1868, as *Dacrydium taxoides*; PILGER, R. *Pflanzenreich* IV. 5 (Heft 18): fig. 4 H-L. 1903, as *Dacrydium falciforme*; Nat. Pflanzenfam. ed. 2. 13: fig. 227 H-L. 1926, as *Dacrydium taxoides*; SARLIN, P. *Bois et Forêts de la Nouvelle-Calédonie*, t. 19. 1954, as *Dacrydium taxoides*.

From *Falcatifolium falciforme* this species differs in its smaller leaves and pollen cones and in the straight rather than upwardly curved leaf tips. From *F. papuanum* it differs in lacking a pungent leaf tip and having distinctly larger leaves. These two species and *F. taxoides* are clearly quite closely related, being geographic segregates. *F. taxoides* is sometimes the host to another conifer as a root parasite (de Laubenfels 1959).

19. *Falcatifolium papuanum* de Laubenfels, sp. nov.

Arbusculus vel arbor ad 22 m. altus; folia patentia, ad apex apiculata, linearia vel ovato-linearia, 12–17 mm. longa, 2–3.5 mm. lata. Strobili masculi ignoti; strobili feminei cum ramulis brevissimis, squamis lanceolatis, 1.0–1.5 mm. longis, bracteis strobilorum ca. 2 mm. longis; semen lateraliter et terminaliter carinatum, 6 mm. longum, 4.5 mm. latum, 3.5 mm. crassum. Holotypus: *de Laubenfels P483* (A), New Guinea, Morobe District. FIG. 6a, b.

DISTRIBUTION. In moist rainforests as an understory plant in the eastern part of the island of New Guinea (possibly in the Vogelkop), from 2,000 to 2,400 meters in elevation. MAP 6.

New Guinea. VOGELKOP: Mt. Nettoti, *Van Royen & Sleumer 8203a* j 1,920 m. (L). TERR. NEW GUINEA: Al R. Mts., *Womersley NGF 5354* s 7,000 ft. (A, BRI, K, L). Mt. Hagan Sta., *Hoogland & Pullen 5891* ♀, j 7,600 ft. (A, BRI, L). Mt. Kum, *Womersley NGF 9419* s 7,000 ft. (BRI, K, L). Nondugl, *Womersley NGF 4483* s 7,000 ft. (A, K, L). Morobe Dist., Edie Creek (Mt. Kaindi), *de Laubenfels P483* ♀ 6,500 ft. (A-holotype; K, RSA, SBT-isotypes), *Brass 29127* s, 7,200 ft. (L), *Womersley NGF 11038* s 6,700 ft. (BRI, K, L), *NGF 13922* ♀ 7,200 ft. (K, L). PAPUA: Mt. Tafa, Cent. Div., *Brass 5107* s 8,000 ft. (BRI, NY). Ridge betw. Adai and Turui Rivers, *Lane-Poole 397* s (A, K).

The apiculate and somewhat small leaves, whose mature size is completely below the considerable range of both *Falcatifolium falciforme* and *F. taxoides*, distinguish this new species. The leaf profile is straight as in *F. taxoides*, but without the rounded tip of that species. The juvenile leaves reach 22 mm. in length and 4 mm. in width. The bark, gray to dark brown, and flaky with large lenticels, and a red-brown inner bark, is not unusual. A remarkable specimen from the Vogelkop, an entire small plant of *Falcatifolium*, has distinctly smaller leaves, 6–10 by 2 mm. (FIG. 6b). Inasmuch as juvenile leaves are usually distinctly larger than those of the adult, it may be that this isolated specimen represents a distinct entity.

20. *Falcatifolium angustum* de Laubenfels, sp. nov.



FIGURE 6. a, *Falcatifolium papuanum* de Laubenfels, portion of the holotype, de Laubenfels P483 (A), slightly enlarged; b [inset], the same, fragment of Van Royen & Sleumer 8203a from the Vogelkop, New Guinea (L), enlarged.

Arbor ad 20 m. alta; folia plantarum iuvenilis acicularia, crassiora quam lata, lanceolata, falcata, patentia, e basi curvata extrinsecus, ad apici curvata sursum, ca. 7 cm. longa, basem versus 1.2 mm. crassa; folia plantarum adultarum minus curvata vel quasi recta, pungentia, carinata



FIGURE 7. a, *Falcatifolium angustum* de Laubenfels, portion of the holotype, Brunig S8866 (L); b, *Dacrycarpus expansus* de Laubenfels, portion of the holotype, Hoogland & Schodde 7463 (L); a and b, approximately natural size.

a latere, 18–35 mm. longa, 1–2.5 mm. crassa; strobili masculi terminales vel laterales, immaturi ovati, 8 mm. longi, 2 mm. diametro; strobili feminei ignoti. Holotypus: Brunig S8866 (L), Sarawak, Bintulu. FIG. 7a.

DISTRIBUTION. At low elevation along the coast of Sarawak.

Sarawak. Bintulu, Brunig S8860 ♂ 300 ft. (L), S8866 ♂ 400 ft. (L-holotype), S963 j 500 ft. (K, L). Kuching, Anderson 12448 s 800 ft. (K).

This distinct new species with its narrow but nevertheless bilaterally flattened leaves is intermediate between the other species of *Falcatifolium* and *Dacrydium*, and seems to represent an early stage of the development of the genus. In the transition between seedling leaves and normal foliage leaves of *F. taxoides* are found leaves of identical morphology to the adult leaves here. The bark is purplish-brown, irregularly flaky to scaly, weathering gray.

[To be continued]

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